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(54) Surgical clip applier

Gerät zum Anbringen von chirurgischen Klammern

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This application relates to an instrument for applying to surgical clip to body tissue, and more particularly to instruments for applying and crimping plastically deformable vascular surgical clips for anastomoses of a blood vessel in conventional surgical procedures and endoscopic or laparoscopic surgical procedures. EP-A-409569 discloses such an instrument, which is in accordance with the precharacterising part of claim 1 below. For later disclosures of similar instruments, see EP-A-538074, US-A-5049152 and EP-A-507537.

2. Discussion of the Prior Art

[0002] The term "anastomosis" covers a variety of procedures in which blood vessels such as veins and arteries, or other tubular members, such as parts of the colon, intestines, stomach, etc., are joined or reconnected. These vessels may be joined in a variety of relative orientations, including end-to-end and end-to-side. Solid tubular structures such as peripheral nerves can also be joined together, as well as solid structures such as subcutaneous tissue and skin.

[0003] The recent advances made in the field of microsurgery has led to the development of alternatives to conventional suturing processes of joining vessels in order to accommodate the minute size of the vessels, nerves and tissues being joined during microsurgical procedures. These alternatives have also been developed with an eye towards preventing thrombosis which tends to occur at the points of penetration of the needle and sutures. An alternative to suturing is the use of surgical clips which are applied along the vessel juncture to perform a holding function similar to that of sutures, but without penetrating the vessel walls. Two such non-penetrating clips are shown in U.S. Pat. Nos. 4,586,503 and 4,733,664 to Kirsch et al. The former patent discloses a surgical microclip formed of plastically deformable metal or plastic material having minimal spring-back when crimped. The clip has a pair of parallel curved legs joined by a bridge at one end and terminating in rounded tips at the other end. The clip grips the edges of adjacent and everted tissue by crimping the legs together. The latter patent discloses a vascular surgical clip comprising a plastically deformable body portion, a tang for deforming the body, and a neck connecting the tang to the body, wherein the neck is designed to break upon application of a predetermined excessive tensile force to the tang, and the body is designed to deform upon application to the tang of less than the predetermined tensile force.

[0004] As described in the above patents, the non-penetrating clips are applied over opposed edges of the vessels, the edges first being everted, or turned outward, to form flanges that are gripped between the jaws of the clips. Eversion not only enables the clip jaws to better grip the vessels, but also insures that only the interior surfaces of the vessels are in contact.

[0005] Vascular microsurgical clips are typically applied with a small hand-held tool that enables the surgeon to precisely place the clip over the tissue edges, and then to close the clip, as by applying a squeezing pressure to the tool. One example of a prior art clip applier for use in vascular microsurgery is disclosed in both U.S. Patent Nos. 4,733,664 and 4,929,240 to Kirsch et al. These patents disclose a tool for applying a surgical clip, the tool including means for gripping and applying tension to the tang of the clip while also having means for simultaneously pushing against shoulders on the clip body. The tool disclosed in these patents requires that a clip be reloaded into the clip applier after each clip is fired, which is disadvantageous in that the vessels being repaired need to be returned to their intended function as quickly as possible, particularly blood vessels. Furthermore, the devices disclosed in these patents and in the prior art generally require relatively large incisions for the surgeon to access the vessel to be repaired.

[0006] The development of laparoscopic and endoscopic surgical procedures and the success of these procedures has led to the need for microsurgical tools such as vascular clip appliers which can be utilized without requiring large incisions. Vascular clip appliers which apply microclips by accessing the surgical site through trocar cannulas would greatly benefit the patient through significantly reduced recovery time.

[0007] The need therefore exists for an instrument for applying such a surgical clip which can be utilized for vascular anastomosis, particularly during endoscopic and laparoscopic surgical procedures. One specific need is for an instrument that can hold a plurality of clips and automatically feed and apply the clips individually to the vessel. It would also be desirable for the instrument to include an elongated body portion which may be placed down a trocar cannula to access the surgical site in an endoscopic or laparoscopic surgical procedure. The instrument needs to be simple to manufacture, easy to manipulate and which applies the clips with consistent accuracy so as to provide a secure joining of vessels and tissue. Since the instrument is intended to apply clips during vascular anastomosis it would be desirable to configure it similarly to other vascular surgical devices, i.e. tweezers or pincer-like implements, which are held between the thumb and forefinger of the user.

SUMMARY OF THE INVENTION

[0008] The present application discloses apparatus defined in claim 1 below, namely, an instrument for applying and crimping plastically deformable vascular surgical clips to a blood vessel during a surgical anastomosis procedure. The clip applier is designed for storage

of multiple clips, and individual, automatic feed of the clips into the jaws of the instrument. Further, the applier is designed so that it can be similar in design to other instruments used during vascular surgical procedures, i.e. to be like a tweezer or other pincer-like implement at the handle end, while preferably also including an endoscopic portion to enable the instrument to be placed through a trocar cannula to access an internal surgical site during an endoscopic or laparoscopic surgical procedure.

[0009] The handle portion can include a pair of handles which effect the closing of the jaws to crimp the clip positioned in the jaws, by advancing a channel assembly during closing of the handles which cams the jaws shut. The handles are oppositely and pivotally connected at the proximal end of the housing and are actuated at their distal ends, thereby improving the tactility and visibility of the working end of applier, as well as the stability of the instrument.

[0010] In operation, the applier initially has a clip positioned between the jaws. Thus, a surgeon places the jaws of the applier about the everted end of the vessels and then squeezes the handles together.

[0011] In another embodiment, the clip applier further includes a rotation knob for rotating the channel, jaw blade assembly, clip cover and a feed mechanism which is independent of the handle. This clip applier may also include a window for viewing a clip indicator which displays approximately how many clips remain in the device. Further, the tip of the jaws may be angled approximately 30 degrees for better visibility during application of the clip. In this embodiment, a spring biased pusher bar is located behind the series of clips and urges the series forward in the distal direction towards the jaws. The jaws include a raised stop portion having an arcuate clip receiving groove which arrests forward or distal movement of the clips and accurately positions the next clip in the jaws for crimping. After the handles are closed to crimp the clip in the jaws, and then are opened to release the crimped clip, the pusher bar urges the series distally to place the next clip in between the jaws.

[0012] In yet another embodiment, the clip applier further includes an elongated portion for insertion through a trocar to perform endoscopic and laparoscopic procedures. A seal may also be provided to prevent inadvertent leakage of the insufflation gas utilized in such procedures. The seal may comprise an O-ring or similar type seal to prevent leakage through the instrument itself. The instrument permits the application of microclips in endoscopic procedures to repair vessels without large incisions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present application will be more fully appreciated as the same becomes better understood from the following detailed description of the present invention when considered in connection with the following drawings in which:

Fig. 1 illustrates a perspective view of a clip applier, not in accordance with what is claimed;
Fig. 2 illustrates an exploded perspective view of the instrument;
Fig. 3 illustrates a top view of the handle of the instrument taken along lines 3-3 of Fig. 1;
Fig. 4 shows a bottom view in partial cross-section of the distal portion of the instrument;
Fig. 5 shows a detailed top view of a unformed clip loaded in the jaws of the instrument;
Fig. 6 shows a detailed top view of a clip being formed in the jaws of the instrument;
Fig. 7 shows an enlarged top view of the jaw blade assembly of the instrument;
Fig. 8 shows an enlarged perspective view of the clip cover of the instrument;
Fig. 9 shows an enlarged perspective view of the jaw blade assembly and clip retainer of the instrument;
Fig. 10 shows an enlarged perspective view of the pusher bar of the instrument;
Fig. 11 shows an enlarged perspective view of the feed bar of the instrument;
Fig. 12 shows a side view of the distal end of the instrument illustrating an unformed clip positioned in the jaws of the instrument;
Fig. 13 shows a side view of the distal end of the instrument illustrating the position of the clip retainer and feed bar after the clip has been formed in the jaws;
Fig. 14 shows an enlarged perspective view of a clip for use with the instrument;
Fig. 15 shows an enlarged top view of the clip of Fig. 14;
Fig. 16 is a perspective view of another instrument, being an instrument in accordance with the invention claimed herein;
Fig. 17 is an exploded perspective view of the instrument of Fig. 16;
Fig. 18 is an enlarged perspective view of the jaw blade assembly of Fig. 17;
Fig. 19 is an enlarged perspective view of the clip cover assembly of Fig. 17;
Fig. 19a is a perspective view of the indicator for showing the number of clips remaining in the clip series;
Fig. 19b is a side cross-section of the indicator in position in the clip cover of Fig. 19;
Fig. 20 is an enlarged bottom view of the clip cover assembly of Fig. 19;
Fig. 21 is an enlarged perspective view of the wedge of Fig. 17;
Fig. 22 is an enlarged perspective view of the knob of Fig. 17;
Fig. 22a is an enlarged, exploded perspective of the keyway connection between the knob of Fig. 22 and

the channel assembly 126 and jaw assembly 114 of Fig. 17;

Fig. 23 is an enlarged, partial top view of the distal end of the jaw blade assembly of Fig. 18;

Fig. 24 shows a detailed top view of an unformed clip loaded in the jaws of the instrument of Fig. 17;

Fig. 25 shows a detailed top view of a clip loaded and formed in the jaws of the instrument of Fig. 17;

Fig. 26 illustrates a perspective view of another embodiment of the present invention, which is an instrument particularly useful for endoscopic procedures;

Fig. 27 illustrates an exploded perspective view of the instrument of Fig. 26;

Fig. 28 illustrates a perspective view of the instrument during an endoscopic surgical procedure in which the instrument is placed through the body wall through the provision of a trocar cannula;

Fig. 29 illustrates a top plan view in partial cross-section illustrating the operating mechanism of the instrument prior to crimping a clip positioned in the jaw assembly; and

Fig. 30 is a view similar to Fig. 29 illustrating the operating mechanism of the instrument as a clip is being crimped in the jaw assembly and applied to the vessel.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0014] Referring now to drawings, in which like reference numerals identify similar or identical elements throughout the several views, and referring in particular to Figs. 1 and 2, a surgical clip applier 10 not in accordance with what is claimed includes a bottom housing 12, a top housing 14, a jaw blade assembly 17 having a pair of jaws, a channel assembly 16 slidably mounted with respect to housings 12, 14, a clip cover 50 and a feed bar 18 slidably mounted in the channel assembly 16. A pair of handles 22 are provided for actuating the clip applier and are pivotably secured to housings 12 and 14 as described below.

[0015] Bottom and top housings 12, 14 are secured together by pivot pin 24 and screws 34. The housings 12, 14 are of slender construction and are made of any suitable material, for example, plastic material. As seen in Fig. 2, the inner surface 13 of the bottom housing 12 is contoured and recessed so as to receive various components of the applier as further explained below. The inner surface 15 of top housing 14 is contoured for similar purposes. The pivot pin 24 extends through the proximal end of the housings 12, 14 and the proximal end of handles 22, as best seen in Fig. 3, to pivotally connect the handles 22 between the inner surfaces of the housings 12, 14 which are spaced apart to form a recess for receiving the handles 22. Spacers 11 are positioned in the housings 12, 14 to help maintain the recess between the housings 12, 14.

[0016] As shown in Fig. 1, the handles 22 are actuable at their distal ends 23, i.e. the end closest to the surgical site. This provides increased visibility, tactility and stability and enables the handles 22 to be held in a tweezer or pincer-like manner.

[0017] Turning now to the jaw blade assembly 17 for forming the clip and with reference to Figs. 2, 7 and 9, jaw blade assembly 17 includes an elongated jaw blade 36 which has a pair of jaws 38 formed at a bifurcated distal end for receiving a surgical clip therein. Each jaw 38 is provided with a small slot or groove in a side wall so as to receive therein a leg of the substantially C-shaped surgical clip 42 shown in Figs. 14 and 15. Each jaw 38 also includes raised portions 39 which act as a stop for the clip cover 50 mounted thereon. The jaw blade 36 has a pair of camming surfaces 41 for engagement by channel assembly 16 to close the jaw in a manner described below.

[0018] The jaw blade assembly 17 also includes along its elongated portion a clip carrier portion 40 upon which a series of clips 42 are positioned. The clip carrier portion 40 is integral with the jaw blade assembly 17, although multiple elements could be used to achieve the same result.

[0019] The proximal, or rear, end of the jaw blade assembly 17 includes a plate 44 having a pair of oppositely positioned openings 46 for receiving the screws 34 which retain the jaw blade assembly 17 within the housings 12, 14. A tail 48 is formed in the proximal-most end of the jaw blade assembly 17 for providing additional support for the pusher bar 90.

[0020] A clip retainer 51 is mounted under the distal end of jaw blade assembly 17. With reference to Figs. 9, 12 and 13, the distal end of the clip retainer 51 has a pair of oppositely positioned side walls 52 and 54 and a raised distal end wall 56. The clip retainer 51 prevents movement in the distal direction of the stack of clips 42 and is movable from a position preventing movement of stack of clips 42, as shown in Fig. 12, to a position in which the stack of clips 42 are able to advance distally, as shown in Fig. 13.

[0021] As shown in Figs. 2 and 11-13, the feed bar 18 is elongated and has a depending nose 84 at its distal end. Nose 84 moves clip retainer 51 into the position shown in Fig. 13 by engagement of the walls 52 and 54 when the feed bar 18 has moved behind a second clip 43 in the series of clips 42, but the first clip 42' is still in the jaws 38 of the jaw assembly.

[0022] As indicated 58, the distal end of the feed bar 18 is angled slightly downwardly with the tip bent up. Feed bar 18 functions to feed the distalmost clip in the series of clips to the jaws and is slidably positioned within channel 64 between rails 66 (see Fig. 8) of the clip cover 50. Feed bar 18 further includes a pair of triangular projections 86 having cam surfaces 87 which cam the feed bar 18 in the proximal direction when the handles 22 are closed, and a proximal abutment 88 for receiving spring 32 as mentioned below.

[0023] Clip cover 50, shown in Figs. 2 and 8, is elongated and similar in shape to the jaw blade assembly 17 and includes a tissue stop 70. The tissue stop 70 extends distally over the jaw blade 36. This tissue stop 70 has a bifurcated distal end which overlies and serves as a guide to prevent tissue from impeding movement of the clip 42' into the jaws 38. The tissue stop 70 has a rounded cut out 53, a slot 60 and a pair of rounded ends 62 at its distal end. Slot 60 is provided for enabling nose 84 of feed bar 18 to access the series of clips 42 to feed clips to the jaws 38. The pair of side walls or rails 66 provide a guide channel 64 for the feed bar 18. The bottom surface 69 of the clip cover 50 is positioned atop jaw blade assembly 17 and includes a pair of downwardly extending side walls or rails 67 between which the series of clips 42 and the pusher bar 90 (see Figs. 2 and 10) are provided.

[0024] Referring again to Figs. 1 and 2, the channel assembly 16, which as mentioned above functions to cam jaws 38 closed, defines an elongated channel shaped member for enveloping the jaw blade assembly 17 and includes a pair of upstanding walls 72, a top wall 74 and a bottom wall 76. The top wall 74 and bottom wall 76 include a cutout 78 at their distal ends, and at the proximal end top wall 74 includes recess 80 which is formed between projections 82. The projections 82 form a female dovetail connector which engages a male dovetail connector 83 of the forming cam 30 and thereby causes movement of the channel assembly 16 upon movement of the forming cam 30, as will be described below.

[0025] With reference to Figs. 2 and 10, elongated pusher bar 90 has oppositely positioned projections 92 and a rounded member 94 extending from its distal end corresponding in shape to the bridge portion of the clips, for engaging and pushing the last and most proximal clip 42" (see Fig. 4) in the series of clips 42 on the clip carrier portion 40. The projections 92 engage the grooves 208 and the rounded member 94 engages the bridge portion 206 of the last clip 42". The proximal end of the pusher bar 90 includes a slot 96 for receiving a spring guide block 98. A coil spring 302 fits within the molded contours of bottom housing 12, and a channel 308 of spring 302 is engaged by the pin 310 which extends through an aperture 311 in the bottom housing 12 to hold the end of spring 302 in place as coiled portion 304 rolls in the distal direction, urging guide block 98 against pusher bar 90. This gently urges the series of clips 42 in the distal direction to continue the feeding, loading and clipping process. The feed spring 302 rolls along the top of its elongated portion 306 as the pusher bar 90 advances the clips 42.

[0026] As shown in Figs. 14 and 15, a surgical clip designed for application by the clip applier 10 is formed of a unitary piece of biologically acceptable, plastically deformable material such as a noble metal (i.e. gold, silver, platinum, titanium etc.). While metal clips are presently preferred, it is contemplated that there is minimal spring-back. The clip is designed to apply contact force to the tissue regardless of tissue thickness without penetration.

[0027] The clip 42 includes a pair of inwardly curved arms 202 and 204 interconnected by a bridge portion 206, the two arms extending generally perpendicular to the bridge portion 206. The arms terminate at tips 210 and 212 which are rounded to prevent injury to the subject tissue. As described above, the bridge portion 206 includes a pair of grooves 208 for engagement by the pusher bar 90 of the clip applier 10 described above and for advancing the clips down the clip carrier 40 in the applier. The clip is sized according to the particular end use, but is generally of a size suitable for microsurgical applications, in both non-endoscopic and endoscopic procedures.

[0028] Turning now to the operation of the instrument, and referring to Figs. 1, 2 and 3, each handle 22 is articulated to the housings 12 and 14, and is operable to effect movement of the channel assembly 16, the feed bar 18, and ultimately the series of clips 42 and the pusher bar 90 in the following manner. Handles 22 are pivotally connected to the housings 12, 14, by pivot pin 24 and extend from the housing on opposite sides as shown. The distal ends of handles 22 are secured by pins 26 which ride along cam slots 28 of forming cam 30. The forming cam 30 is connected at its distal end through the dovetail connection 82, 83 to the channel assembly 16, as is discussed in detail above, and near its proximal end post 29 is connected to a spring 32. The other end of the spring is attached to the proximal end of the feed bar 18 at abutment 88 and biases feed bar 18 in a distal direction. Thus, the spring 32 biases the channel assembly 16 and the forming cam 30 in a proximal direction, such that the handles 22 are biased to an open position, while at the same time biasing feed bar 18 in a distal direction.

[0029] Since each handle is connected in a similar fashion, only the connection of one of the handles will be discussed. As indicated in Figs. 2 and 3, the channel assembly 16 is mounted at the distal end of forming cam 30 at dovetail connection 82, 83 while the feed bar 18 is attached at abutment 88 through spring 32 to the post 29 at proximal end of forming cam 30. Thus, referring to Fig. 3, when handles 22 close together, the pins 26 move along slots 28 of forming cam 30 to distally advance the forming cam 30 which correspondingly advances the channel assembly 16 against the biasing of spring 32. As seen in phantom in Fig. 3, feed bar 18 underlies forming cam 30 and is positioned such that cam surfaces 87 abut pins 26 as shown. As handles 22 are closed, pins 26 also ride over cam surfaces 87, thus moving feed bar 18 in a proximal direction and further extending spring 32, which is concurrently being pulled in the distal direction by forming cam 30. After the channel assembly 16 advances a slight distance distally, e. g. approximately 0.5 mm (.020 inch), the nose 84 of the feed bar 18 moves proximally to a position behind the

next clip 43 in the clip carrier 40, as seen in Fig. 13.

[0030] In use, the clip applier 10 is provided with a clip 42' already in the jaws 38 of the jaw blade assembly 17, and feed bar 18 is in the position shown in Figs. 4 and 5 to hold clip 42 in place as it is fit over a vessel. To apply the clip, the handles 22 are first squeezed together overcoming the bias of spring 32 and causing the channel assembly 16 and forming cam 30 to move forwardly (or distally), while at the same time, the feed bar 18 moves rearwardly (or proximally) as pins 26 engage cam surfaces 87, into a position to feed the second clip 43 from the series of clips 42 on clip carrier 40 as described above. As the channel assembly 16 moves forwardly and over jaws 38 of the jaw blade assembly 17, the jaws 38 are cammed closed to form the clip 42' therein, as seen in Fig. 6. As the jaws 38 close and feed bar 18 moves proximally, the nose 84 of the feed bar 18 moves behind the second clip 43, as seen in Fig. 6, and the first clip 42' is fully formed in the jaws 38. The clip retainer 51, as seen in Figs. 12 and 13, then is biased downwardly by engagement with the nose 84 of feed bar 18.

[0031] As the handles are released, handles 22 automatically open under the influence of spring 32, which pulls forming cam 30 proximally and pushes feed bar 18 distally causing pins 26 to ride in slots 28 to open handles 22. The clip retainer 51 continues to be biased downwardly, and the feed bar18 moves forward and advances the next clip 43 to the jaws 38, due to pins 26 riding over cam surfaces 87 as spring 32 biases feed bar 18 in the distal direction. Furthermore, as pins 26 ride in slots 28 of forming cam 30, cam 30 moves proximally under the influence of spring 32, drawing channel assembly 16 with it. The downward biasing of the clip retainer 51 also permits the stack of clips 42, which are normally biased in a forward direction by spring 302, to advance forward and move distally, to position the next distalmost clip in position for loading after the crimping of clip 43.

[0032] Referring now to Fig. 16, the surgical clip applier 100 of an embodiment of the present applier includes a bottom housing 102, a top housing 104, a jaw blade assembly 114 having a pair of jaws 118, and a channel assembly 126 slidably mounted with respect to housings 102, 104. A pair of handles are provided for actuating the clip applier and are pivotably secured to housings 102 and 104.

[0033] The bottom and top housings 102, 104 are press fit and held together by the engagement of pin 109 with the pin receiver 119 and by the engagement of pins 121 with holes 129, but alternatively may be welded or joined by other suitable means. The housings 102, 104 are of slender construction are made of any suitable material, for example, plastic material. As indicated, the inner surface 106 of the bottom housing 102 is contoured and recessed so as to receive various components of the applier as further explained below. The inner surface of top housing 104 is contoured for similar purposes. The pivot pin 109 extends from the proximal end of the housing 104 to pivotally connect the handles 101, 103 between the inner surfaces of the housings 102, 104, which are spaced apart to form a recess for receiving the handles 101, 103. The housing 104 also includes a window 111 through which fluted 140 knob 138 extends as seen in Fig. 16.

[0034] The handles 101, 103 are actuable at their distal ends 105, i.e. the end closest to the surgical site. This provides increased visibility, tactility and stability and enables the handles 101, 103 to be held in a tweezer or pincer-like manner. The handles 101, 103 are biased outwardly by a spring 107 which fits in slots 107a of each handle member and is retained by the spring post 131 formed on the inner surface 106 of the bottom housing 102.

[0035] Turning now to the jaw blade assembly 114 for forming the clip 42 and with reference to Figs. 17, 18, and 23 jaw blade assembly 114 includes an elongated jaw blade 116 which has a pair of jaws 118 formed at a bifurcated distal end for receiving a surgical clip therein. Each jaw 118 receives a leg of the substantially C-shaped surgical clip 42 from the series of clips 158. Each jaw 118 also includes raised portions 120 which act in a manner similar to raised portions 39 as described above, as a stop for the clip 42 to enhance formation thereof. The raised portions 120 include an arcuate portion 235 which conforms in shape to the leg of the clip 42, as seen in Figs. 24 and 25. Arcuate portion 235 arrests forward or distal movement of the distalmost clip 42 as series of clips 158 is urged distally by spring 148. The jaw blade 116 has a pair of camming surfaces 124 which are engaged by channel assembly 126 to close the jaw 118 in a manner described below. The jaws 118 are bent at an angle of approximately 30 degrees to enhance visibility of the structure to which the clip 42 is being applied. Another feature of the jaws 118 is that they are flexible and deformable and preferably formed of stainless steel.

[0036] The jaw blade assembly 114 also includes along its elongated portion a clip carrier portion 128 upon which series of clips 158 are positioned. Clips 158 are retained in the side walls 170 of the clip cover 122, shown in Figs. 19 and 20. In this embodiment the clip carrier portion 128 is integral with the jaw blade assembly 114, although multiple elements could be used to achieve the same result. Jaw assembly 114 also is provided with keyway slot 250 whose purpose will be described below.

[0037] Clip cover 122, shown in Figs. 17, 19 and 20 is elongated and similar in shape to the jaw blade assembly 114 and includes a tissue stop 160. The tissue stop 160 extends distally over the jaws 118, and has a bifurcated distal end which overlies and serves as a gulde to prevent tissue from moving the clip 42 proximally and out of raised portions 120. The tissue stop 160 has a rounded cut out 162, and a pair of rounded ends 166 at its distal end. The bottom surface 168 of the clip cover 122 is positioned atop jaw blade assembly 114

and includes a pair of downwardly extending side walls or rails 170 between which the series of clips 158 are retained and the pusher bar 134 and indicator 136 are provided. Indicator 136 is shown in detail in Fig. 19a and its position within clip cover 122 is shown in Fig. 19b. The proximal end of the clip cover 122 includes a pair of downwardly extending key portions 145 which engage cut outs 147 in the jaw blade assembly 114.

[0038] Referring to Figs. 16 and 17, the channel assembly 126, which as mentioned above functions to cam jaws 118 closed, is U-shaped and includes a reduced height portion 172 at its proximal end for engagement with the rotation knob 138 at keyway slot 251a as will be described below. Channel 126 also has at its proximal end a transverse slot 164 for engaging a link 144 as will be described below. The channel 126 envelops the jaw blade assembly 114 and includes a pair of upstanding walls 174, 176 and a bottom wall 175. The side walls 174, 176 each include an inturned flange 178, 180, respectively, at its top side, formed therein for engagement around the top surface of clip cover 122. Inturned flanges 178 and 180 serve to lock the assembly together, which includes cover 122, series of clips 158, pusher bar 134, indicator 136, jaw assembly 118 and rod 142. The reduced height portion 172 of the channel assembly 126 includes slot 164, and reduced height portion 172 extends through a passageway 184 in the knob 138 and matingly engages corresponding annular flange 186 formed in the link 144 to permit rotational movement of the entire assembly by knob 138.

[0039] Referring to Fig. 22a, there is shown the keyway connection between knob 138 within passageway 184 with channel assembly 126 and jaw assembly 114. Jaw assembly 114 is provided with a keyway slot 250 which matingly engages keyway post 185a in a secure manner. Keyway post 185a passes through slot 251a in channel assembly 126 so that the channel assembly may slide in response to movement of the handles. Keyway slot 250 locks jaw assembly 114 against longitudinal movement, but permits rotational movement due to knob 138. Channel assembly 126 is permitted to slide over post 185a and through knob 138 to crimp a clip in jaws 118 as described below, due to the provision of slot 251a. As can be appreciated, slot 251a is longer and wider than slot 250, and post 185a as well.

[0040] Elongated pusher bar 134 has a plurality of transversely extending grooves 135 in its distal end to provide flexibility as it advances up the approximately 30 degree incline of the jaws 118 to feed the last few clips to the jaws. Otherwise the pusher bar 134 is similar to pusher bar 90 as is shown in Fig. 10 for engaging and pushing the last and most proximal clip of series 158 on the clip carrier 128. A coil spring 148 fits within the molded contours of bottom housing 102 and cooperates with the spring guide block 146 to bias and advance rod 142, which in turn advances indicator 136 and pusher bar 134 distally, thereby advancing series of clips 158.

[0041] Link 144 is provided and facilitates both rotational movement and longitudinal movement. Link 144 translates longitudinal actuation of the forming cam 154 into movement of the channel 126. An annular flange 186 in the link 144 engages slot 164 in the channel assembly 126 to longitudinally actuate the channel 126 in response to movement of the handles. It should be noted that while the flange 186 and slot 164 engagement permits movement of the channel assembly 126 along its longitudinal axis, the slot 164 is also free to rotate about the annular flange 186 in response to rotation of the knob 138, thus rotating the entire assembly. A rod 142 extends, and moves longitudinally through the link 144, but is not actuated by the link. The proximal end of the rod 142 engages the spring guide block 146 to translate the bias or tension of the spring 148 to the pusher bar 134 by its abutment at its distal end to the clip indicator 136 as shown in Figs. 19a and 19b, and hence pusher bar 134. Forming cam 154 is secured to link 144 by-arms 155, which fit about link 144 and into cutouts 196, as described below.

[0042] Referring now to Figs. 17 and 22, the knob 138 retains the proximal ends of and rotates the entire distal assembly including the jaw blade assembly 114, the series of clips 158, the clip indicator 136, the pusher bar 134, the channel 126 and the clip cover 122. The knob 138 receives a wedge 150 as shown in Fig. 21 which provides a friction fit of the jaw blade assembly 114 and clip cover 122 within the knob 138, thereby enabling their rotation in response to rotation of the knob 138 but permitting longitudinal movement of pusher bar 134 and channel 126.

[0043] Turning now to the operation of the device 100, each handle 101, 103 is articulated to the housings 102 and 104 and is operable to effect movement of the channel assembly 126. Handles 101, 103 are pivotally connected to opposite sides of the housings 102, 104 and engage pins 108 which ride along cam slots 156 of forming cam 154. The forming cam 154 is connected by a pair of arms 155 at its distal end to the cutouts 196 of the link 144. As indicated in Fig. 17, the channel assembly 126 is mounted at slot 164 to the distal end of link 144 at flange 186 while the proximal end of link 144 is attached at cutouts 196 to the distal end of forming cam 154 at arms 155. Thus, when handles 101, 103 close together against the biasing of spring 107, the pins 108 move along slots 156 of forming cam 154 to distally advance the forming cam 154 which correspondingly advances link 144 and the channel assembly 126. Channel assembly 126 engages jaws 118 of jaw assembly 114 at camming surfaces 124 to close the jaws.

[0044] In use, the clip applier 100 is provided with a clip 42 already in the jaws 118 of the jaw blade assembly 114. To apply the clip 42, the handles 101, 103 are first squeezed together overcoming the bias of spring 107 and causing the channel assembly 126 to move distally as described above and over jaws 118 of the jaw blade assembly 114. As best shown in Fig. 25, this movement over the jaws 118 cams the jaws 118 closed causing the

raised portions 120 of the jaws 118 to form the clip 42 therein. The flexibility of the jaws 118 prevents trauma to tissue in which the clip 42 is being applied by not further forming the clip 42 or damaging tissue once the clip 42 has been formed. This trauma is prevented by the jaw arms which absorb the overstroke and deflect once the clip 42 has been fully formed and the jaws 118 are closed, but the channel assembly is still advancing. As the handles 101, 103 open, the formed clip 42 is released from the jaws 118, and the pusher bar 134 is advanced distally to advance the next clip 42' to the jaws 118. The clip is retained in the jaws by the raised portions 120 and arcuate portion 235. The clips are urged forward as a group, and are held from being forced back in a proximal direction by each other in conjunction with pusher bar 134. The clip indicator 136 may be viewed through the window 123 on the clip cover 122 to display approximately how many clips in series 158 are left in the device 100.

[0045] Turning to the embodiment shown in Fig. 26, there is illustrated an endoscopic clip applier for the application of microclips in an endoscopic or laparoscopic surgical procedure. Heretofore, although prior art devices have been developed for the application of surgical clips in endoscopic surgical procedures, it has not been possible to store multiple clips and individually apply microclips (without individually loading each clip) during such procedures due to the minute size of the clips and the correspondingly small size of the components of the clip applier. The device of Fig. 26 provides such a microclip applier, particularly suited for endoscopic and laparoscopic microsurgical procedures.

[0046] Referring to Figs. 26 and 27, instrument 400 is provided which includes endoscopic body portion 402 for accessing remote surgical sites in endoscopic or laparoscopic surgical procedures. Instrument 400 is substantially identical to instrument 100 as described above with reference to Figs. 16-25, except for the elongated portion defined by endoscopic body portion 402 and the elongation of the channel 172 and rod 142 disposed therein. As seen in Fig. 27, endoscopic body portion 402 includes top tube portion 404 and bottom tube portion 406, which substantially enclose the clip applying mechanism which includes channel assembly 126, jaw assembly 114, series of clips 158, pusher bar 134, indicator 136 and clip cover 122. Bottom tube 406 includes keyway post 185b which passes through slot 251b in channel assembly 126, and is matingly engaged in a secure manner in slot 250 to permit longitudinal movement of channel assembly 126 while preventing longitudinal movement of jaw assembly 114. This permits channel assembly 126 to move to crimp a clip positioned in jaws 118. As explained with reference to Fig. 22a above, slot 251b is wider and longer than post 185b and slot 250 in jaw assembly 114. With reference to Figs. 27 and 22a, slot 250a engages post 185a in knob 138 to secure the endoscopic body portion 402 to knob 138 to facilitate rotation of body portion 402.

[0047] A seal device such as O-ring 408 is provided and is positioned within endoscopic body portion 402 substantially enclosing the assembly formed by clip cover 122, series of clips 158, pusher bar 134, jaw assembly 114 and channel assembly 126. O-ring 408 substantially surrounds these components and is wedged between top tube portion 404 and bottom tube portion 406 to prevent the leakage of gas through the instrument during the endoscopic surgical procedure.

[0048] Typically, in an endoscopic surgical procedure, the cavity is insufflated with gas such as carbon dioxide to inflate the cavity to permit the surgeon to access the surgical objective without interference from adjacent tissue and organs. Accordingly, it is desirable to provide some sort of seal means in the endoscopic portion of the instrumentation to prevent the inadvertent leakage of the insufflation gas through the instrument itself. O-ring 408 is shown for illustration purposes only, and it is contemplated that any suitable seal mechanism may be provided within endoscopic body portion 402.

[0049] Fig. 28 illustrates the present instrument in use during an endoscopic surgical procedure. After the body cavity is insufflated, a trocar assembly is utilized to puncture the body wall 414 to provide access for the surgical instrumentation to perform the endoscopic or laparoscopic surgical procedure. After the trocar assembly is put in place, the instrument is inserted through trocar housing 410 and trocar cannula 412 and exits the trocar assembly adjacent the surgical site. In the illustration shown in Fig. 28, a pair of severed vessels, typically a blood vessel, are to be rejoined. The vessels are placed adjacent each other and their ends everted by the surgeon using instrumentation suited for this purpose. Once the everted ends 420 are placed adjacent each other, the instrument is utilized to apply clips 42 about the circumference of the everted vessels to join them together. The surgeon will apply as many clips as necessary to rejoin the severed vessels 416 and 418.

[0050] Figs. 29 and 30 illustrate the present invention in operation. Fig. 29 illustrates the instrument in the at rest condition where the jaw assembly 114 is positioned adjacent a pair of vessels 416 and 418 to be joined. The everted ends 420 are placed side by side and the jaw assembly positioned over the everted ends to apply the microclip. As seen in Fig. 29, handles 101, 103 are in their at rest condition where pins 108 are at the distalmost position in slots 156 of forming cam 154. The distal end of forming cam 154, namely arms 155, engage the cutouts 196 and link 144, which is further connected as described above to channel assembly 126 at slot 164. Rod 142 passes through link 144 beneath forming cam 154 and engages guide block 146 at its proximal end and indicator 136 at its distal end to urge the series of clip 158 in a distal direction.

[0051] In order to crimp a clip 42 positioned in the jaws 118, handles 101, 103 are closed in the direction of arrow "A" as indicated in Fig. 30. As the handles are closed, pins 108 ride in cam slots 156 of forming cam

154 to move forming cam 154 in the distal direction. As this occurs, link 144 is moved in a distal direction which consequently moves channel assembly 126 in the distal direction as indicated by arrow "B". As channel assembly 126 moves in the distal direction, the distal end of channel assembly 126 engages camming surfaces 124 of jaws 118 to cam the jaws closed and crimp the clip 42 positioned therebetween. When handles 101, 103 are released, spring 107 (as shown in Fig. 27) returns the instrument to the position shown in Fig. 29.

[0052] The claims which follow identify embodiments of the invention additional to those described in detail above.

Claims

1. Apparatus (100) for applying and crimping plastically deformable vascular surgical clips in vascular surgical procedures comprising:

   - a handle portion (102, 104, 101, 103):
   - an elongate body portion (114) extending from said handle portion:
   - a pair (118) of jaw members extending from said body portion at an end opposite said handle portion and movable between an open position for receiving a clip (158) in a gap between the jaw members (118) and a closed position for crimping a clip present in said gap, in response to movement of said handle portion;
   - a plurality of plastically deformable, crimpable, open clips (158) disposed within said body portion, said plurality of clips being arranged in line such that each clip in said plurality is contacted by at least one other clip, said line having a distalmost clip and a proximalmost clip; each said clip having a pair of arcuate legs, spaced apart in an open disposition of the clip but closer together after the clip has been crimped; and
   - a camming mechanism (126) associated with said body portion for camming said jaw members from said open position to said closed position to crimp closed the said distalmost open clip of said line; and
   - pusher bar advancing means (134) for engaging and pushing said proximalmost clip of said line (158), thereby distally advancing said line (158) of clips to urge said distalmost clip (42) of said line (158) distally;

   characterized in that:

   - each said jaw member (118) has a raised portion (120) including an arcuate portion (135) adapted each to conform in shape to one of the arcuate legs of the distalmost clip (42) of said line (158) to arrest its distal movement in the open position of said jaw members as said line (158) is urged distally by said pusher bar advancing means (134); and
   - said raised portion (120) further including a stop portion against which abuts the next-to-distalmost clip (42') as said line (158) is urged distally by said pusher bar advancing means (134) when the jaw members (118) are in their closed position to crimp the distalmost clip (42) of said line (158), but which do not abut the said next-to-distalmost clip (42') of said line (158) when the jaw members (118) are in their open position.

2. Apparatus for applying vascular surgical clips according to claim 1, wherein said jaw members (118) are disposed at an angle with respect to a longitudinal axis of said body portion.

3. Apparatus for applying vascular surgical clips according to either of the preceding claims, wherein said handle portion includes a housing (102, 104) and a pair of handles (101, 103) pivotally connected to said housing and actuable in a tweezer-like manner, each of said handles having a proximal and a distal end and being pivotally mounted to said housing at said proximal ends.

4. Apparatus for applying vascular surgical clips according to claim 3, further comprising first spring means (107) connected between said handles (101, 103); and
second spring means (148) biasing said pusher bar advancing means (134) in a distal direction to push said distalmost clip to a position between said jaw members (118) in response to opening of said handles.

5. Apparatus for applying vascular surgical clips according to any of the preceding claims, further comprising rotation control means (138) for effectuating rotation of said elongate body portion (114) and said jaw members (118) with respect to said handle portion.

6. Apparatus for applying vascular surgical clips according to claim 5, wherein the elongate body portion (114) includes a keyway slot (250) which matingly engages a keyway post (185a) in said rotation control means, said keyway slot locking said elangate body portion (114) against longitudinal movement but permitting rotation movement.

7. Apparatus for applying vascular surgical clips according to any of the preceding claims, wherein said jaw members (118) are integral with said elongate body portion (114) and said camming mechanism includes a channel (126) enveloping the elongate body portion (114).

8. Apparatus for applying vascular surgical clips according to claim 7, as dependent on claim 6, wherein said channel (126) includes an elongate slot (251a) which slides over said keyway post (185a) to permit longitudinal movement.

9. Apparatus for applying vascular surgical clips according to any of the preceding claims, further comprising an endoscopic body portion (402) configured and dimensioned for insertion through a trocar cannula.

10. Apparatus for applying vascular surgical clips according to claim 9,
wherein said endoscopic body portion (402) is a tubular portion (404, 406) substantially enclosing said clips (158), said pusher bar advancing means (134) and said camming mechanism (126).

11. Apparatus for applying vascular surgical clips according to any one of the preceding claims,
further comprising a seal (408) to prevent passage of gas through the apparatus during an endoscopic surgical procedure.

Patentansprüche

1. Vorrichtung (100) zum Anbringen und Umbiegen plastisch verformbarer chirurgischer Gefäßklammern bei chirurgischen Gefäßverfahren, umfassend:

- einen Griffbereich (102, 104, 101, 103);

- einen langgestreckten Körperbereich (114), der sich von dem Griffbereich erstreckt;

- ein Paar (118) von Klemmbackenelementen, die sich von dem Körperbereich an einem Ende entgegengesetzt dem Griffbereich erstrecken und zwischen einer offenen Position und zur Aufnahme einer Klammer (158) in einen Zwischenraum zwischen den Klemmbakkenelementen (118) und einer geschlossenen Position bewegbar sind, um eine in dem Zwischenraum vorhandene Klammer auf eine Bewegung des Griffbereichs hin umzubiegen;

- eine Mehrzahl von plastisch verformbaren, umbiegbaren offenen Klammern (158), die innerhalb des Körperbereichs angeordnet sind, wobei die Mehrzahl von Klammern in einer Reihe angeordnet sind, so dass jede der Mehrzahl von Klammern von zumindest einer anderen Klammer berührt wird, wobei die Reihe eine am weitesten distal gelegene Klammer und eine am weitesten proximal gelegene Klammer besitzt; wobei jede der Klammern ein Paar von bogenförmigen Beinen besitzt, die in einer offenen Anordnung der Klammer voneinander beabstandet sind, aber näher zusammen sind, nachdem die Klammer umgebogen worden ist; und

- einen Verschiebemechanismus (126), der dem Körperbereich zugeordnet ist, um die Klemmbackenelemente von der offenen Position in die geschlossene Position nockenartig zu verschieben, um die am weitesten distal gelegene offene Klammer der Reihe umzubiegen; und

- eine Schieberstangen-Vorrückeinrichtung (134), um die am weitesten proximal gelegene Klammer der Reihe (158) in Eingriff zu nehmen und zu schieben und dabei die Reihe (158) von Klammern in distaler Richtung vorzurücken, um die am weitesten distal gelegene Klammer (42) der Reihe (158) in distaler Richtung zu drücken;

dadurch gekennzeichnet, dass

- jedes der Klemmbackenelemente (118) einen erhöhten Bereich (120) mit einem bogenförmigen Bereich (135) besitzt, die beide angepasst sind, um in Bezug auf die Form mit einem der bogenförmigen Beine der am weitesten distal gelegenen Klammer (42) der Reihe (158) übereinzustimmen, um ihre distale Bewegung in der offenen Position der Klemmbackenelemente anzuhalten, wenn die Reihe (158) durch die Schieberstangen-Vorrückeinrichtung (134) in distaler Richtung gedrückt wird; und

- der erhöhte Bereich (120) weiterhin einen Anschlagbereich aufweist, gegen den die der am weitesten distal gelegenen Klammer benachbarte Klammer (42') anschlägt, wenn die Reihe (158) durch die Schieberstangen-Vorrückeinrichtung (134) in distaler Richtung gedrückt wird, wenn die Klemmbackenelemente (118) in ihrer geschlossenen Position sind, um die am weitesten distal gelegene Klammer (42) der Reihe (158) umzubiegen, die aber nicht gegen die zur am weitesten distal gelegenen Klammer benachbarten Klammer (42') der Reihe (158) anstößt, wenn die Klemmbackenelemente (118) in ihrer offenen Position sind.

2. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß Anspruch 1, wobei die Klemmbackenelemente (118) in einem Winkel in Bezug auf die Längsachse des Körperbereichs angeordnet sind.

3. Vorrichtung zum Anbringen von chirurgischen Gefäßklammern gemäß einem der vorhergehenden Ansprüche, wobei der Griffbereich ein Gehäuse (102, 104) und ein Paar von Griffen (101, 103) aufweist, die schwenkbar mit dem Gehäuse verbunden und in einer zangenartigen Weise betätigbar sind, wobei jeder der Griffe ein proximales und ein distales Ende hat und schwenkbar an dem Gehäuse an den proximalen Enden angebracht ist.

4. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß Anspruch 3, weiter umfassend eine erste Federeinrichtung (107), die zwischen den Griffen (101, 103) verbunden ist; und eine zweite Federeinrichtung (148), welche die Schieberstangen-Vorrückeinrichtung (134) in einer distalen Richtung vorrückt, um die am weitesten distal gelegene Klammer in eine Position zwischen den Klemmbackenelementen (118) auf ein Öffnen der Griffe hin zu schieben.

5. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß einem der vorhergehenden Ansprüche, weiter umfassend eine Drehregeleinrichtung (138), um eine Drehung des langgestreckten Körperbereichs (114) und der Klemmbakkenelemente (118) in Bezug auf den Griffbereich zu bewirken.

6. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß Anspruch 5, wobei der langgestreckte Körperbereich (114) einen Keilnutenschlitz (250) aufweist, der in zusammenpassender Weise mit einem Keilnutenpfosten (185a) in der Drehregeleinrichtung in Eingriff tritt, wobei der Keilnutenschlitz den langgestreckten Körperbereich (114) gegen eine Längsbewegung sperrt, aber eine Drehbewegung erlaubt.

7. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß einem der vorhergehenden Ansprüche, wobei die Klemmbackenelemente (118) einstückig mit dem langgestreckten Körperbereich (114) sind und der Verschiebemechanismus eine Rinne (126) aufweist, welche den langgestreckten Körperbereich (114) umschließt.

8. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß Anspruch 7, sofern dieser von Anspruch 6 abhängig ist, wobei die Rinne (126) einen langgestreckten Schlitz (251a) aufweist, der sich über den Keilnutenpfosten (185a) verschiebt, um eine Längsbewegung zu erlauben.

9. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß einem der vorhergehenden Ansprüche, weiter umfassend einen endoskopischen Körperbereich (402), der gestaltet und dimensioniert ist zum Einführen durch eine Trokarkanüle.

10. Vorrichtung zum Anbringen chirurgischer Gefäßklammern gemäß Anspruch 9, wobei der endoskopische Körperbereich (402) ein röhrenförmiger Bereich (404, 406) ist, der im Wesentlichen die Klammern (158), die Schieberstangen-Vorrückeinrichtung (134) und den Verschiebemechanismus (126) umschließt.

11. Vorrichtung zum Anbringen von chirurgischen Gefäßklammern gemäß einem der vorhergehenden Ansprüche, weiter umfassend eine Dichtung (408), um den Durchtritt von Gas durch die Vorrichtung während eines endoskopischen chirurgischen Verfahrens zu verhindern.

Revendications

1. Appareil (100) pour appliquer et rabattre des pinces chirurgicales vasculaires plastiquement déformables dans des procédures chirurgicales vasculaires comprenant :

   - une portion de poignée (102, 104, 101, 103) ;
   - une portion de corps oblongue (114) s'étendant à partir de ladite portion de poignée ;
   - une paire (118) d'éléments de mâchoire s'étendant à partir de ladite portion de corps à une extrémité opposée à ladite portion de poignée et déplaçable entre une position ouverte pour recevoir une pince (158) dans un espace entre les éléments de mâchoire (118), et une position fermée pour rabattre une pince présente dans ledit espace, en réponse à un mouvement de ladite portion de poignée ;
   - plusieurs pinces ouvertes plastiquement déformables, aptes à être rabattues (158) disposées dans ladite portion de corps, ladite pluralité de pinces étant agencée en rangée de telle sorte que chaque pince de ladite pluralité vienne en contact avec au moins une autre pince, ladite rangée possédant une pince la plus distale et une pince la plus proximale ; chaque pince précitée comportant une paire de branches arquées, espacées dans une position ouverte de la pince mais plus rapprochées après que la

pince a été rabattue ; et

- un mécanisme de came (126) associé à ladite portion de corps pour déplacer par effet de came lesdits éléments de mâchoire de ladite position ouverte à ladite position fermée pour fermer, en la rabattant, ladite pince ouverte la plus distale de ladite rangée ; et

- un moyen (134) faisant avancer une barre de poussée pour venir en prise avec et pousser ladite pince la plus proximale de ladite rangée (158) en faisant avancer ainsi distalement ladite rangée (158) de pinces afin de solliciter ladite pince la plus distale (42) de ladite rangée (158) distallement ;

caractérisé en ce que :

- chaque élément de mâchoire précité (118) présente une portion relevée (120) incluant une portion arquée (135), chacun apte à s'adapter, de par sa forme, à l'une des branches arquées de la pince la plus distale (42) de ladite rangée (158) pour arrêter son mouvement distal dans la position ouverte desdits éléments de mâchoire lorsque ladite rangée (158) est sollicitée distalement par ledit moyen (134) faisant avancer la barre de poussée ; et

- ladite portion relevée (120) incluant en outre une portion de butée contre laquelle bute la pince (42') qui fait suite à la pince la plus distale lorsque ladite rangée (158) est sollicitée distalement par ledit moyen (134) faisant avancer la barre de poussée lorsque les éléments de mâchoire (118) sont dans leur position fermée pour rabattre la pince la plus distale (42) de ladite rangée (158), mais contre laquelle ne bute pas ladite pince (42') qui fait suite à la pince la plus distale, de ladite rangée (158) lorsque les éléments de mâchoire (118) sont dans leur position ouverte.

2. Appareil pour appliquer des pinces chirurgicales vasculaires selon la revendication 1, où lesdits éléments de mâchoire (118) sont disposés selon un angle relativement à un axe longitudinal de ladite portion de corps.

3. Appareil pour appliquer des pinces chirurgicales vasculaires selon l'une des revendications précédentes, où ladite portion de poignée comporte un boîtier (102, 104) et une paire de poignées (101, 103) reliées d'une manière pivotante audit boîtier et actionnables à la manière de brucelles, chacune desdites poignées possédant une extrémité proximale et une extrémité distale et étant montée d'une manière pivotante sur ledit boîtier auxdites extrémités proximales.

4. Appareil pour appliquer des pinces chirurgicales vasculaires selon la revendication 3, comprenant en outre un premier moyen formant ressort (107) connecté entre lesdites poignées (101, 103) ; et

un second moyen formant ressort (148) sollicitant ledit moyen (134) faisant avancer la barre de poussée dans une direction distale pour pousser ladite pince la plus distale dans une position entre lesdits éléments de mâchoire (118) en réponse à l'ouverture desdites poignées.

5. Appareil pour appliquer des pinces chirurgicales vasculaires selon l'une des revendications précédentes, comprenant en outre un moyen de commande de rotation (138) pour effectuer la rotation de ladite portion de corps oblongue (114) et desdits éléments de mâchoire (118) relativement à ladite portion de poignée.

6. Appareil pour appliquer des pinces chirurgicales vasculaires selon la revendication 5, où la portion de corps oblongue (114) présente une fente de clavette (250) dans laquelle s'engage d'une manière appariée un montant de clavette (185a) dans ledit moyen de commande de rotation, ladite fente de clavette verrouillant ladite portion de corps oblongue (114) à l'encontre d'un mouvement longitudinal mais permettant un mouvement de rotation.

7. Appareil pour appliquer des pinces chirurgicales vasculaires selon l'une des revendications précédentes, où lesdits éléments de mâchoire (118) sont intégraux avec ladite portion de corps oblongue (114), et ledit mécanisme de came comporte un canal (126) enveloppant la portion de corps oblongue (114).

8. Appareil pour appliquer des pinces chirurgicales vasculaires selon la revendication 7, dépendant de la revendication 6, où ledit canal (126) comporte une fente oblongue (251a) qui coulisse sur ledit montant de clavette (185a) pour permettre un mouvement longitudinal.

9. Appareil pour appliquer des pinces chirurgicales vasculaires selon l'une des revendications précédentes, comprenant en outre une portion de corps endoscopique (402) configurée et dimensionnée pour l'insertion à travers une canule de trocart.

10. Appareil pour appliquer des pinces chirurgicales vasculaires selon la revendication 9, où ladite portion de corps endoscopique (402) est une portion tubulaire (404, 406) sensiblement enfermant lesdites pinces (158), ledit moyen (134) faisant avancer

la barre de poussée et ledit mécanisme de came (126).

11. Appareil pour appliquer des pinces chirurgicales vasculaires selon l'une des revendications précédentes, comprenant en outre un joint d'étanchéité (408) pour empêcher un passage de gaz à travers l'appareil pendant une procédure chirurgicale endoscopique.

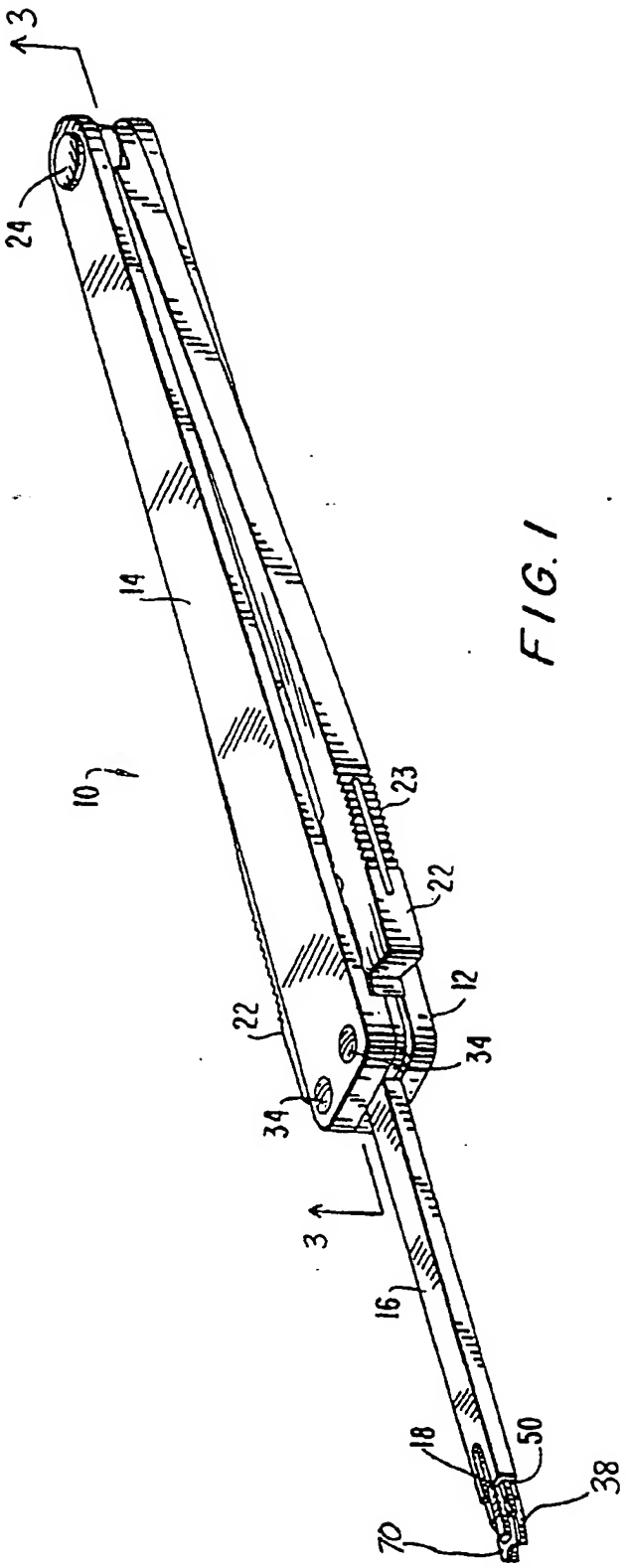
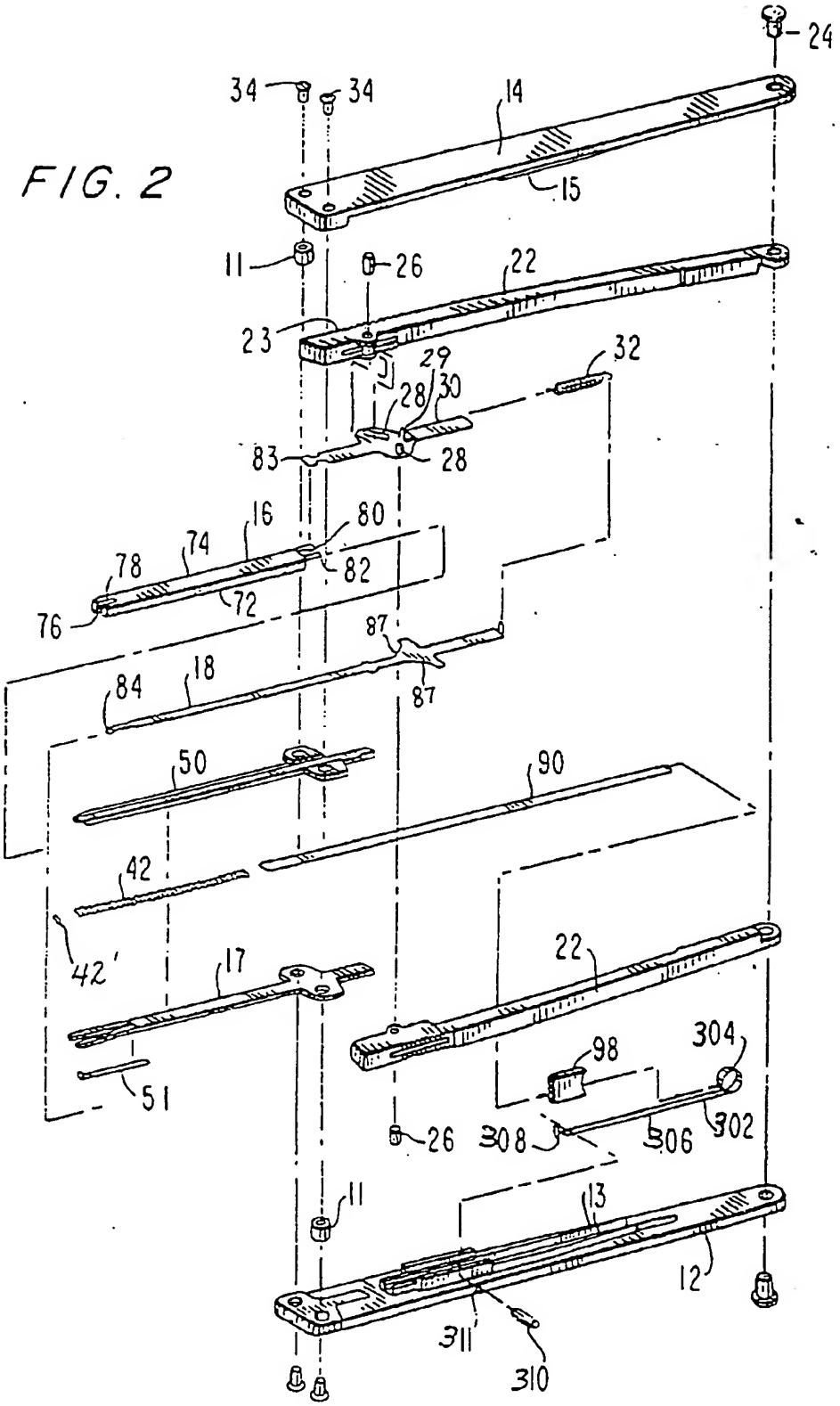


FIG. 1

FIG. 2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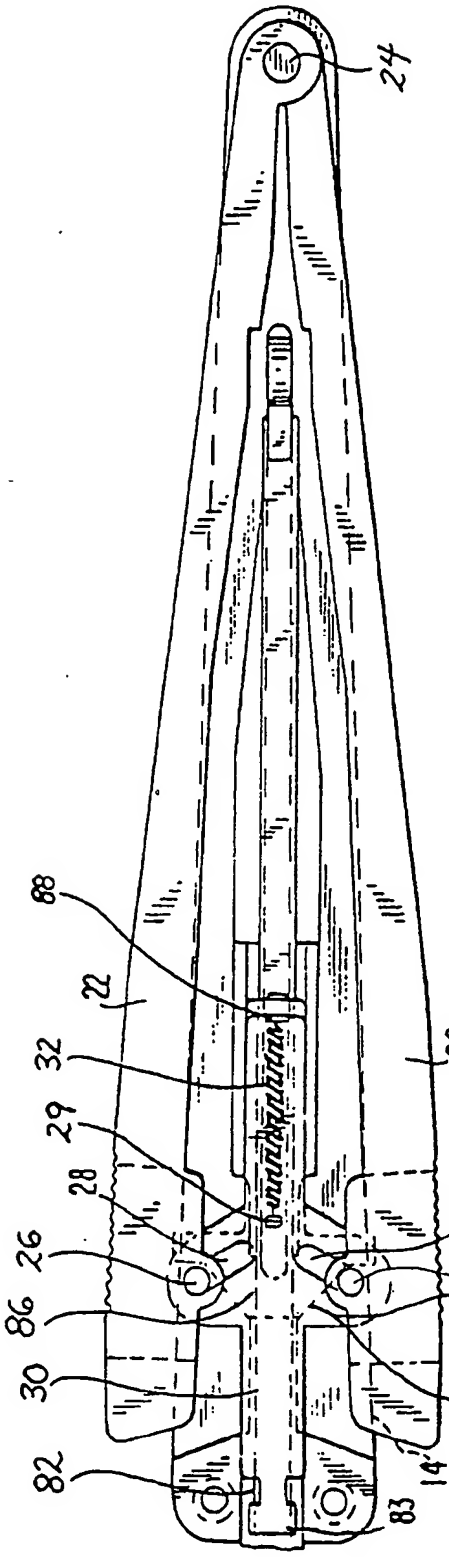


FIG. 3

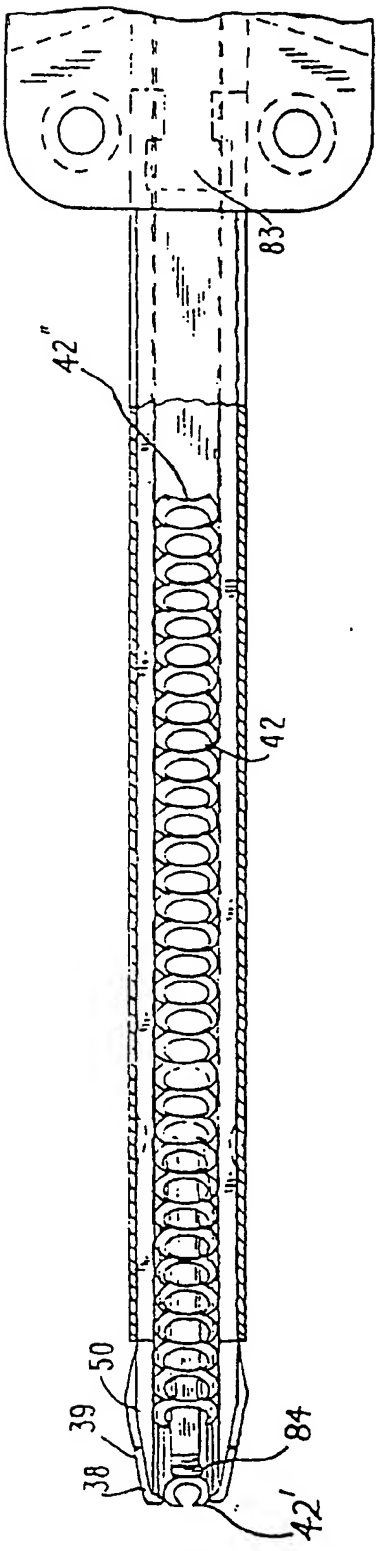


FIG. 4

FIG. 5

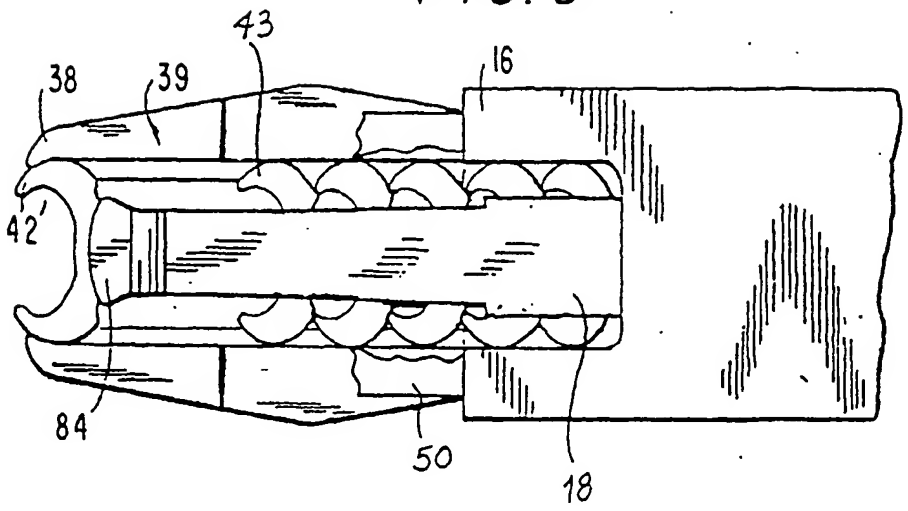
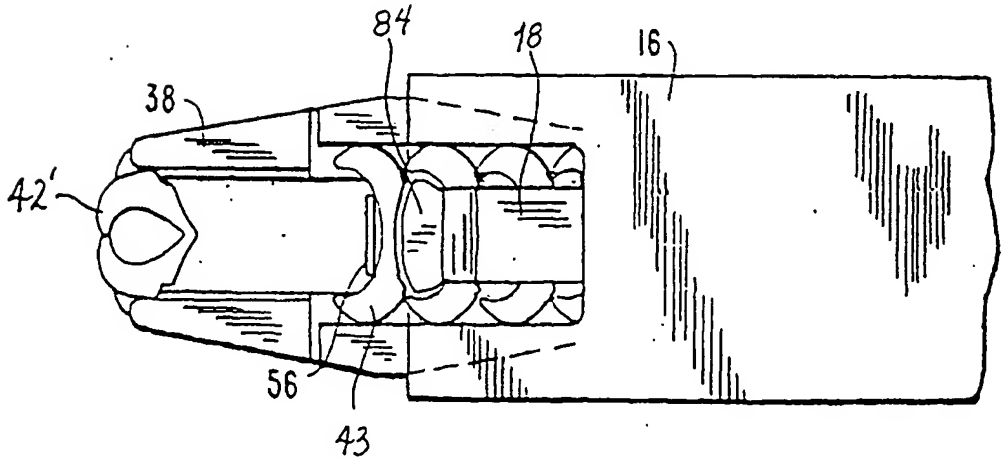


FIG. 6



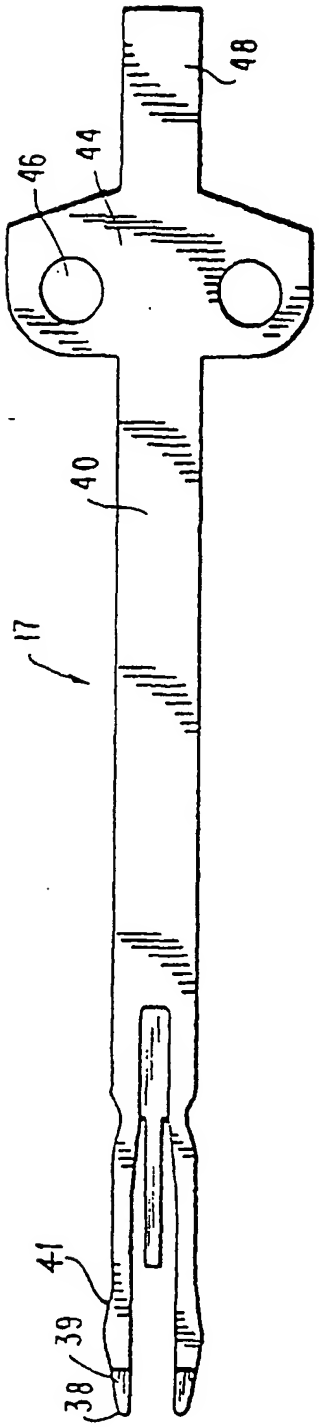


FIG.7

FIG. 8

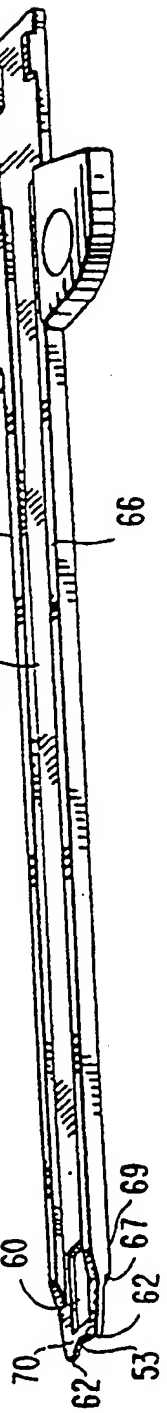

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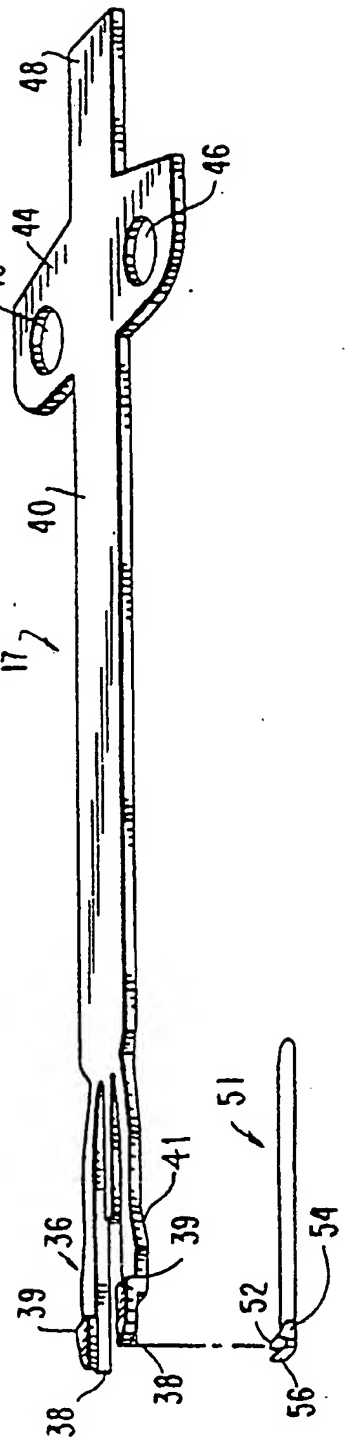
FIG. 9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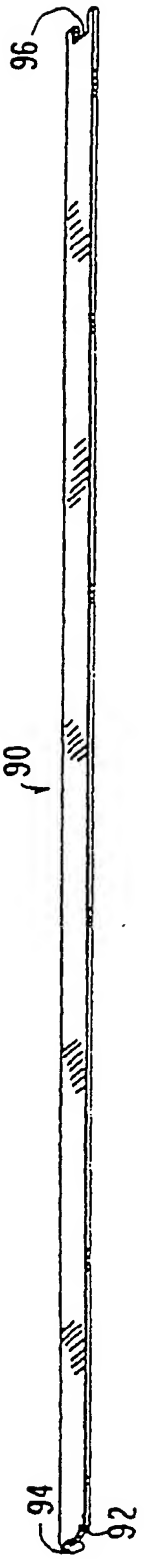


FIG.10

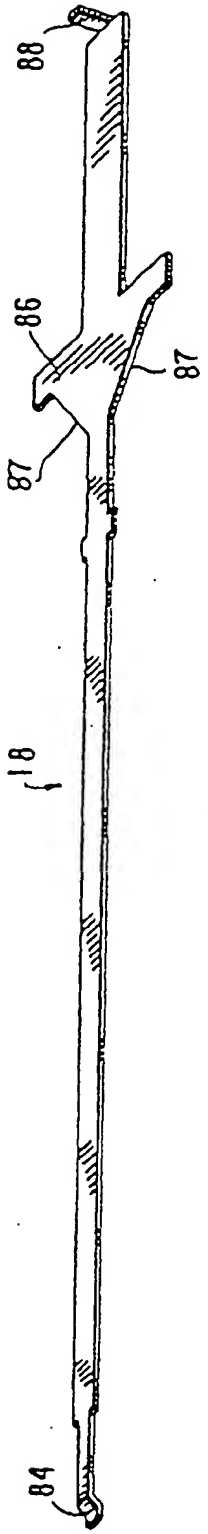


FIG.11

FIG. 12

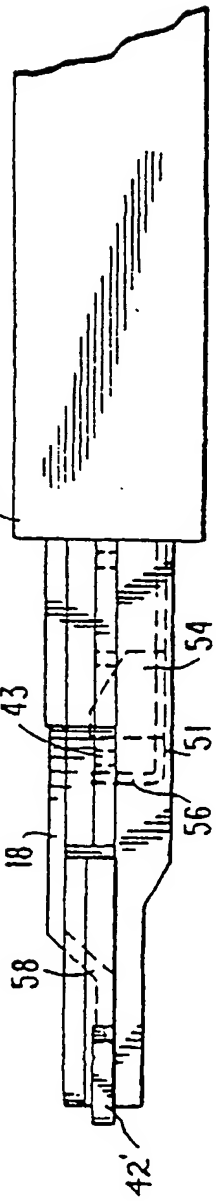


FIG. 13

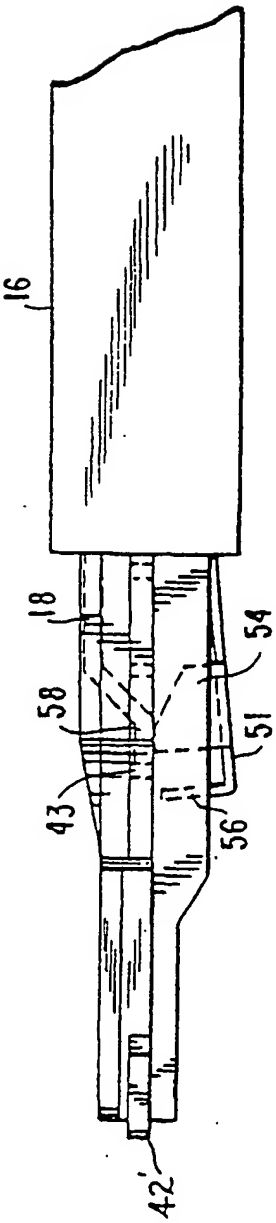


FIG. 14

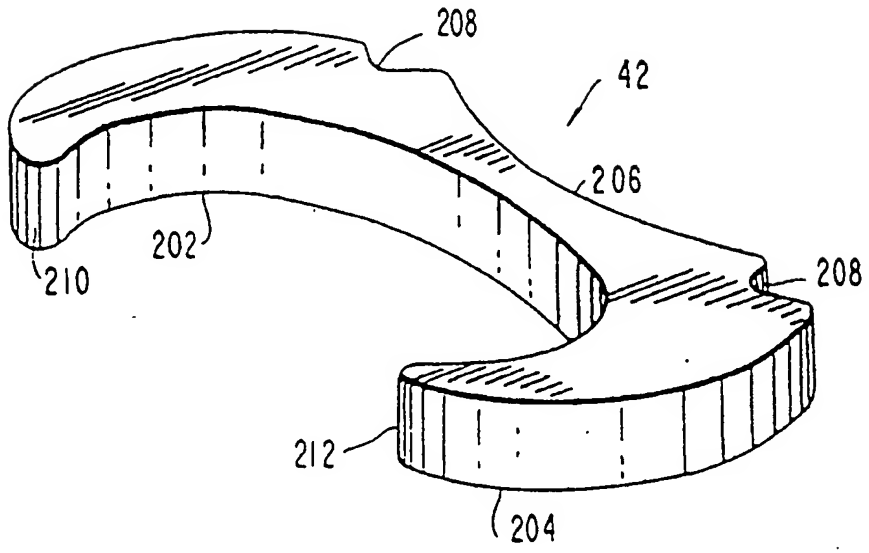
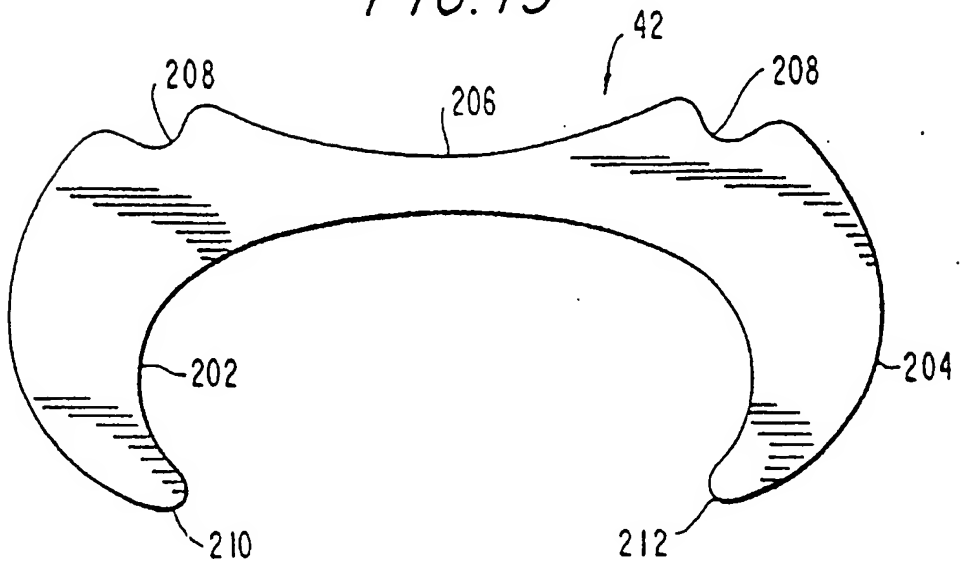


FIG. 15



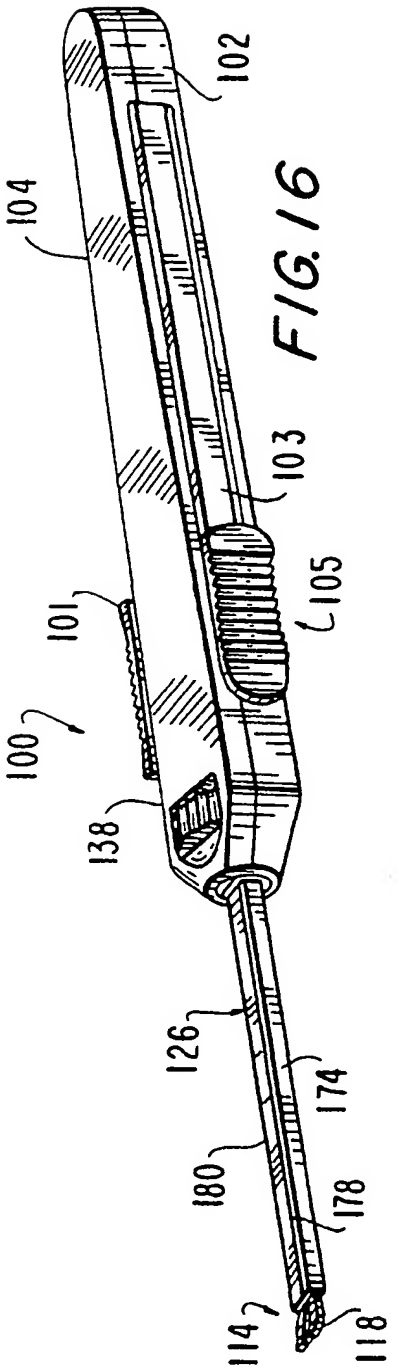

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FIG. 16

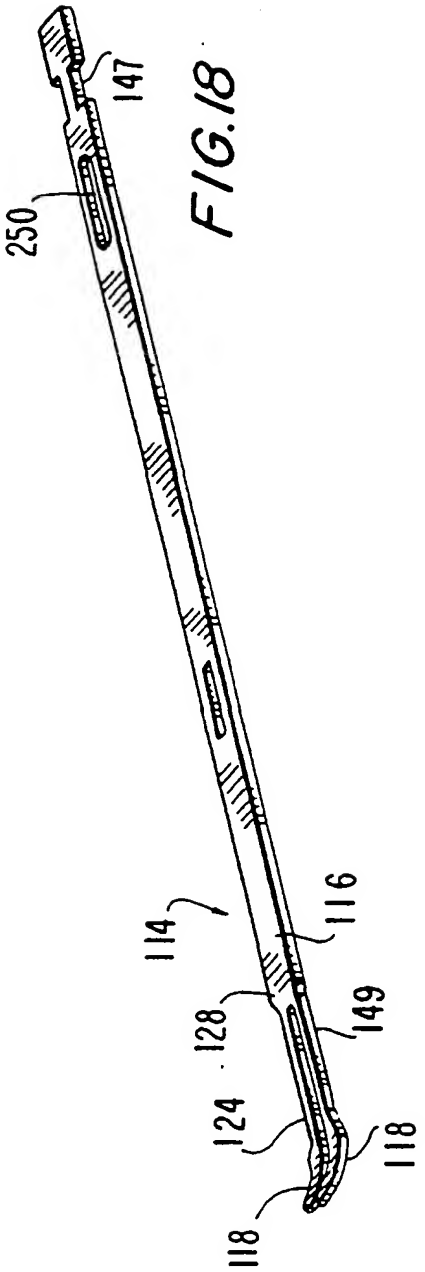
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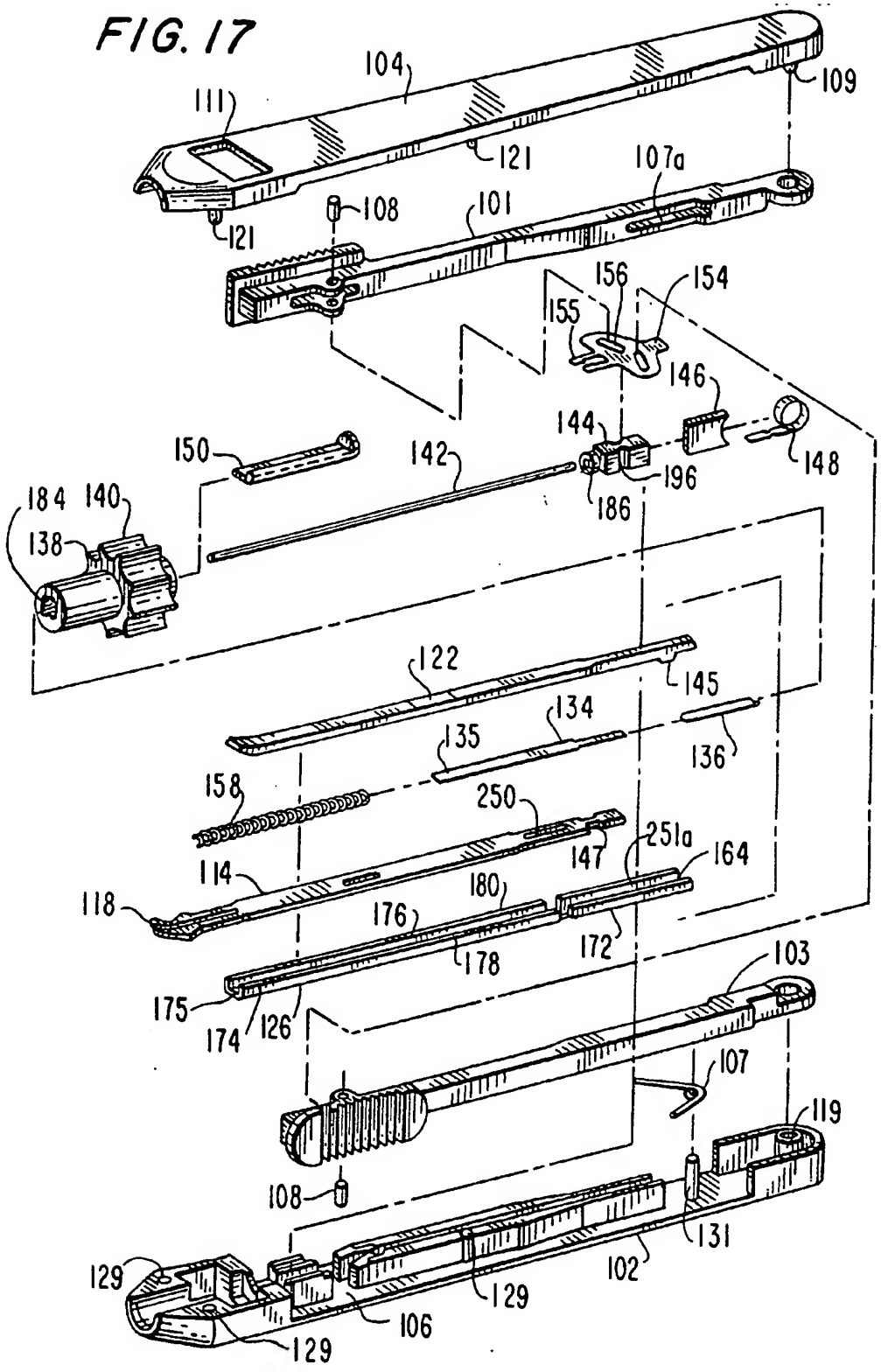
FIG. 18

FIG. 17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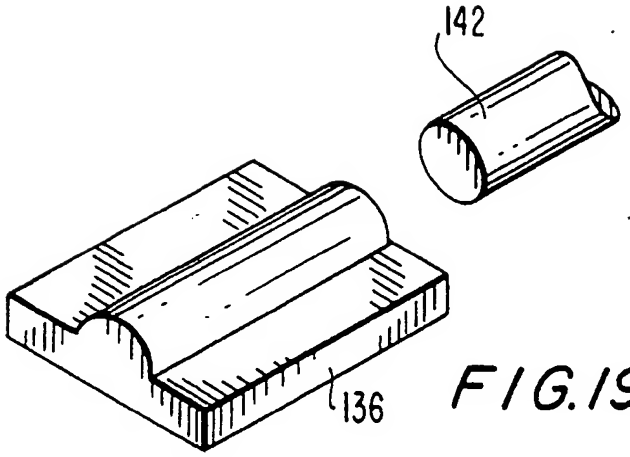


FIG. 19a

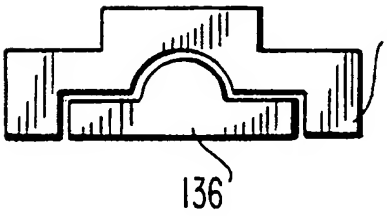


FIG. 19b

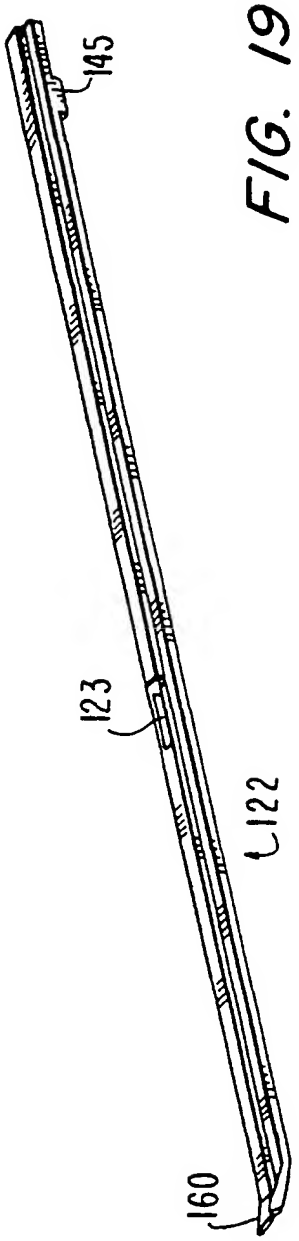


FIG. 19

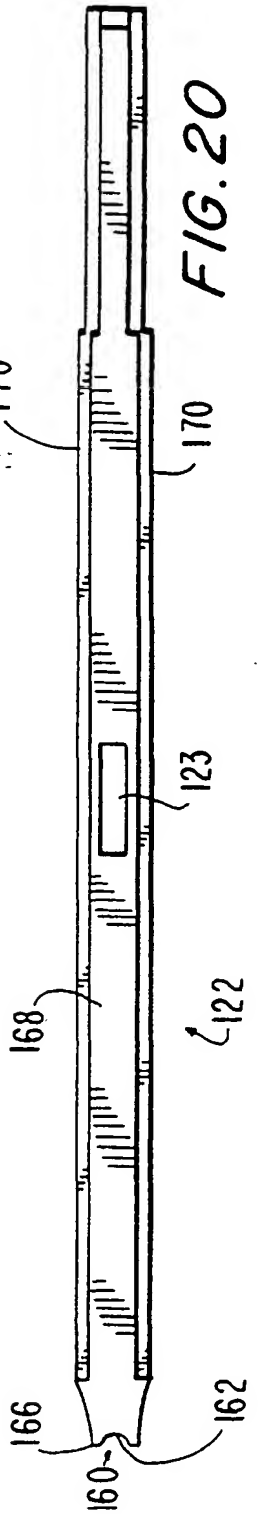


FIG. 20

FIG. 23

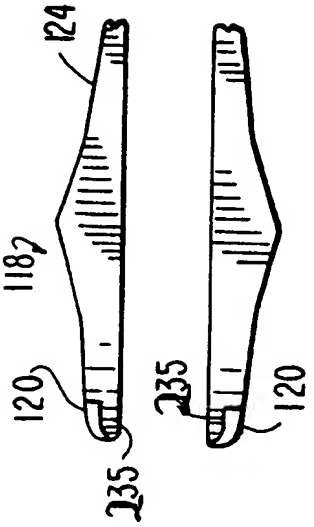


FIG. 21

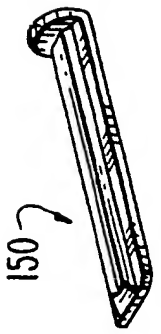
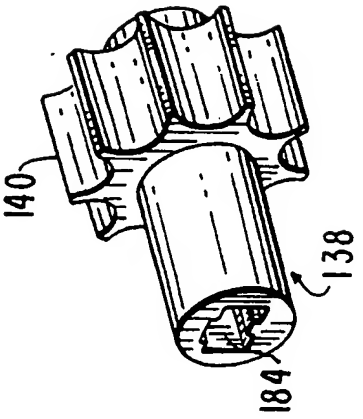


FIG. 22



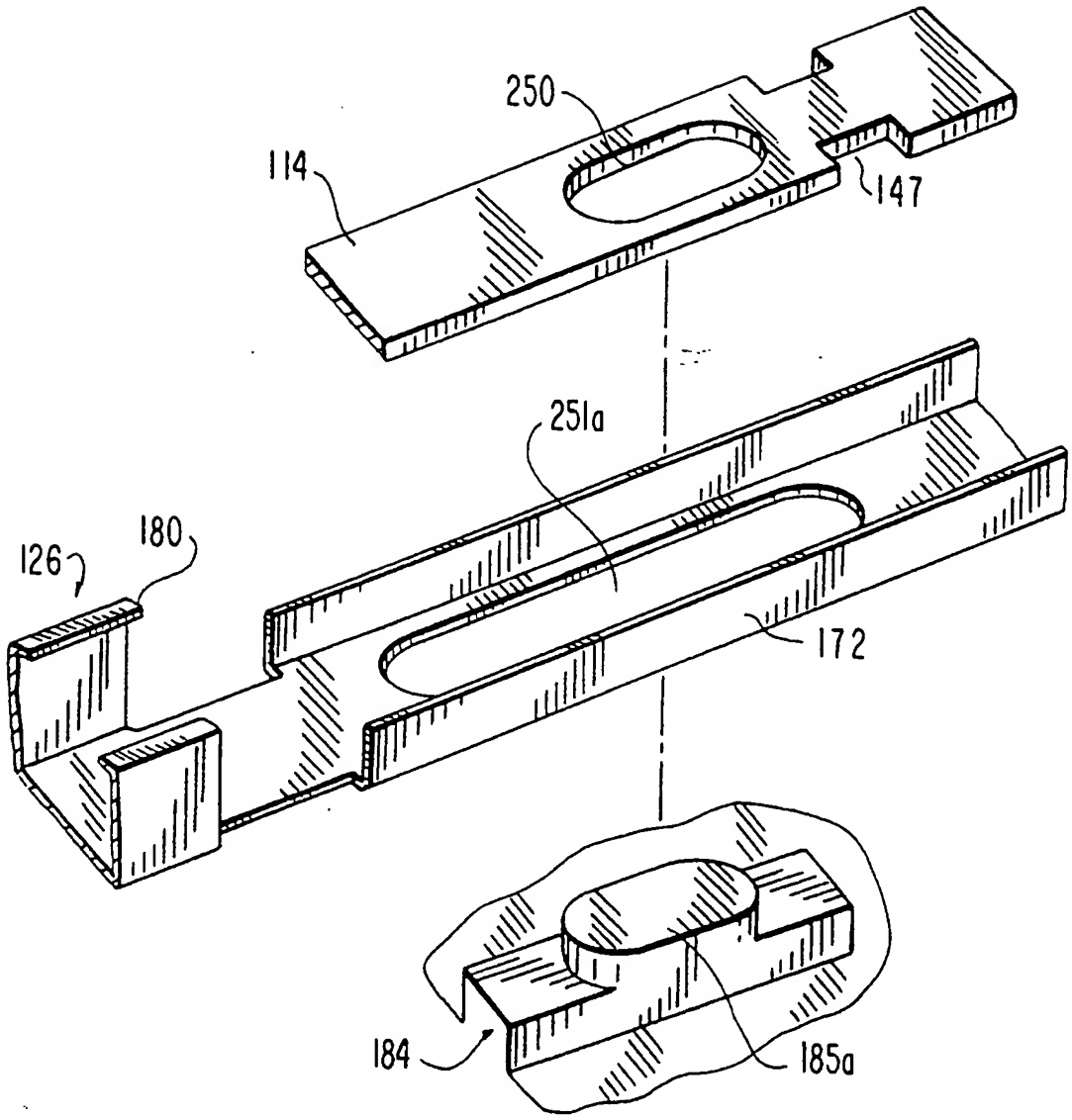


FIG. 22a

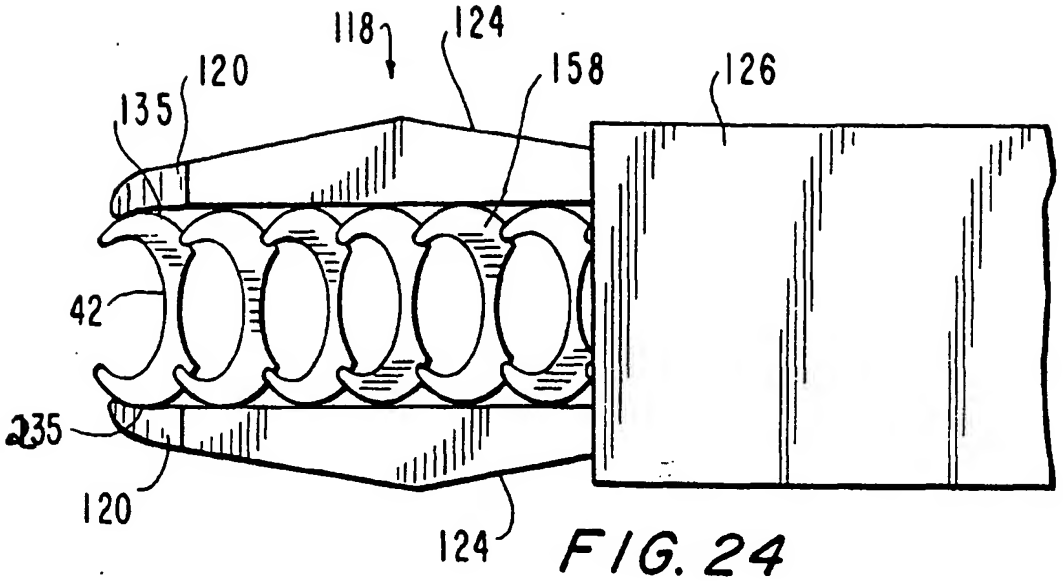


FIG. 24

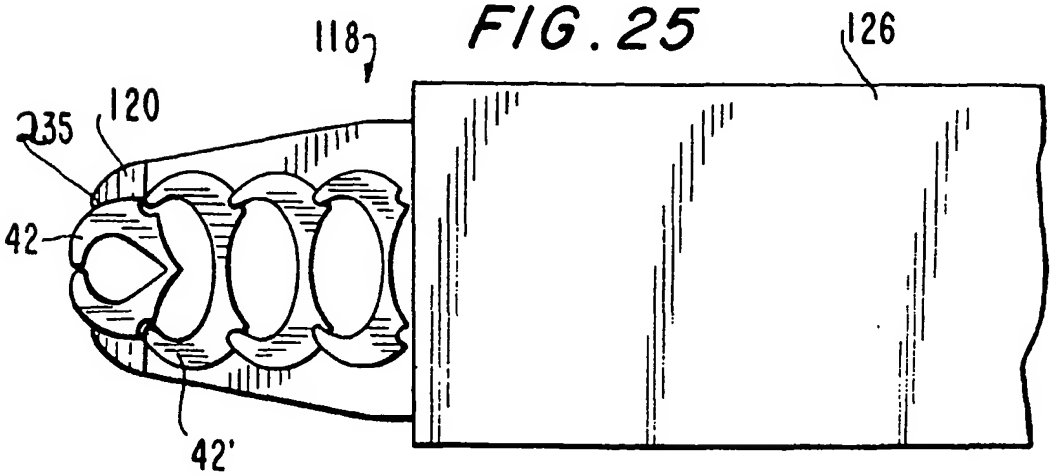


FIG. 25

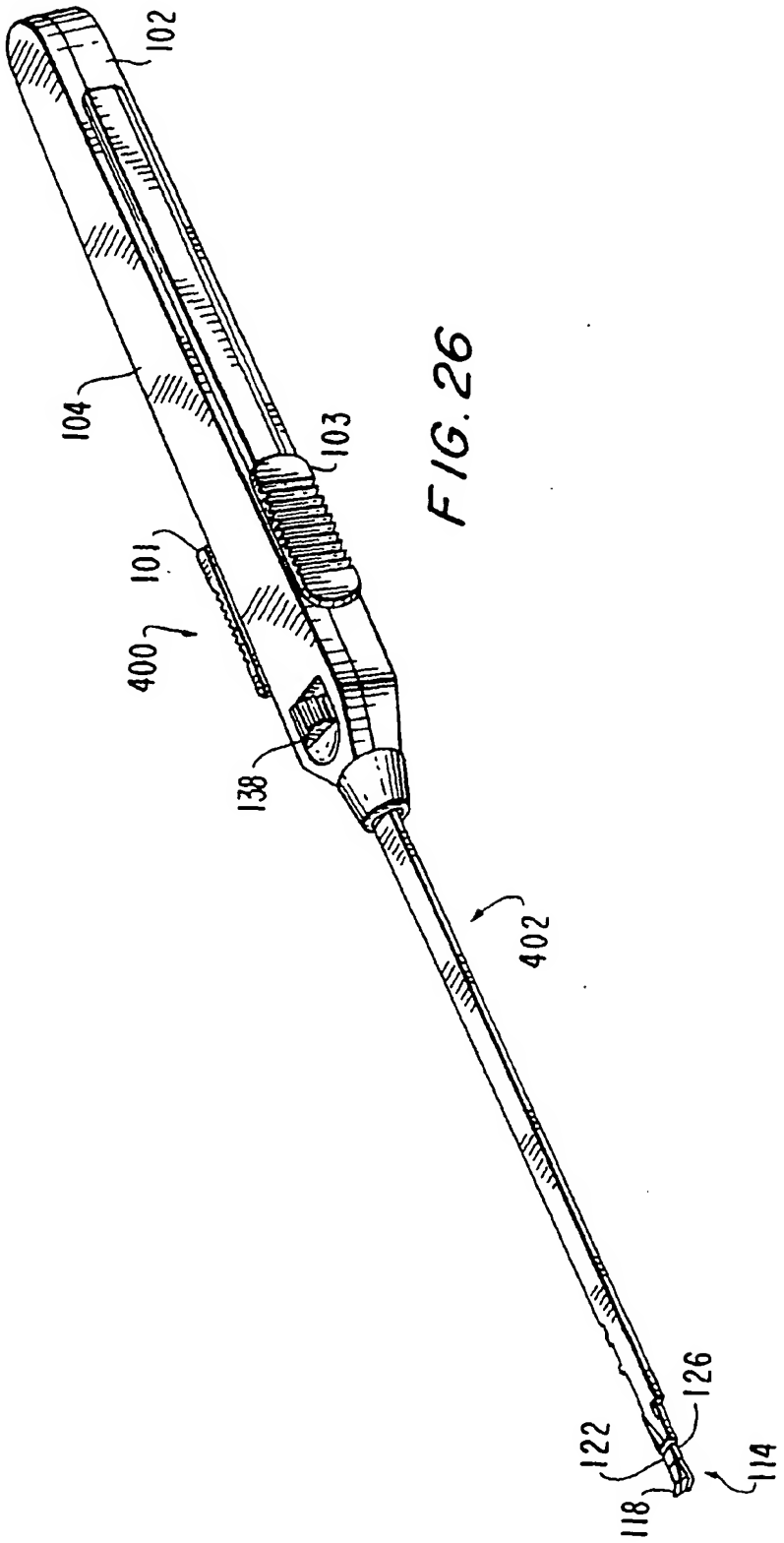


FIG. 26

FIG. 27

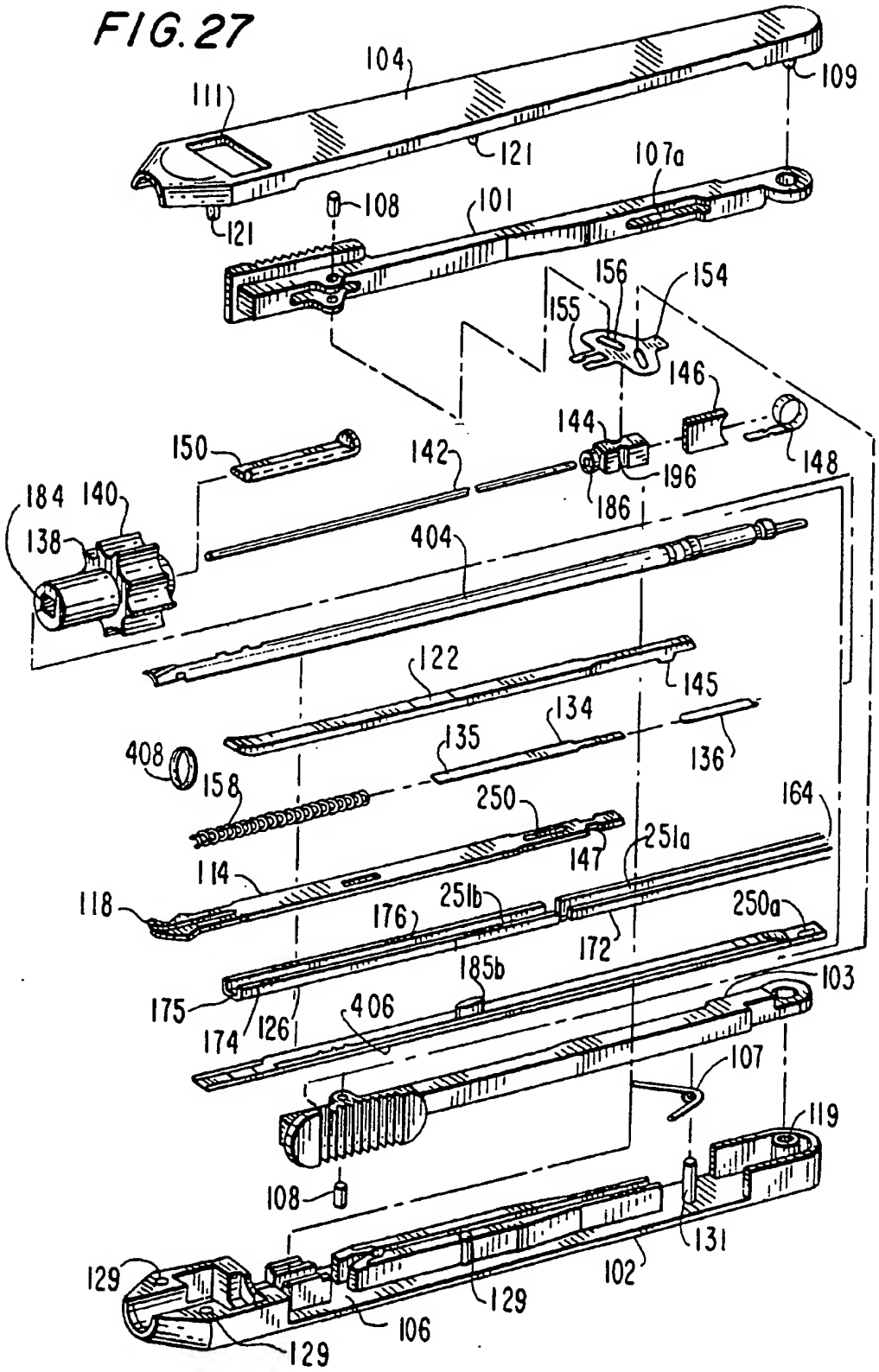

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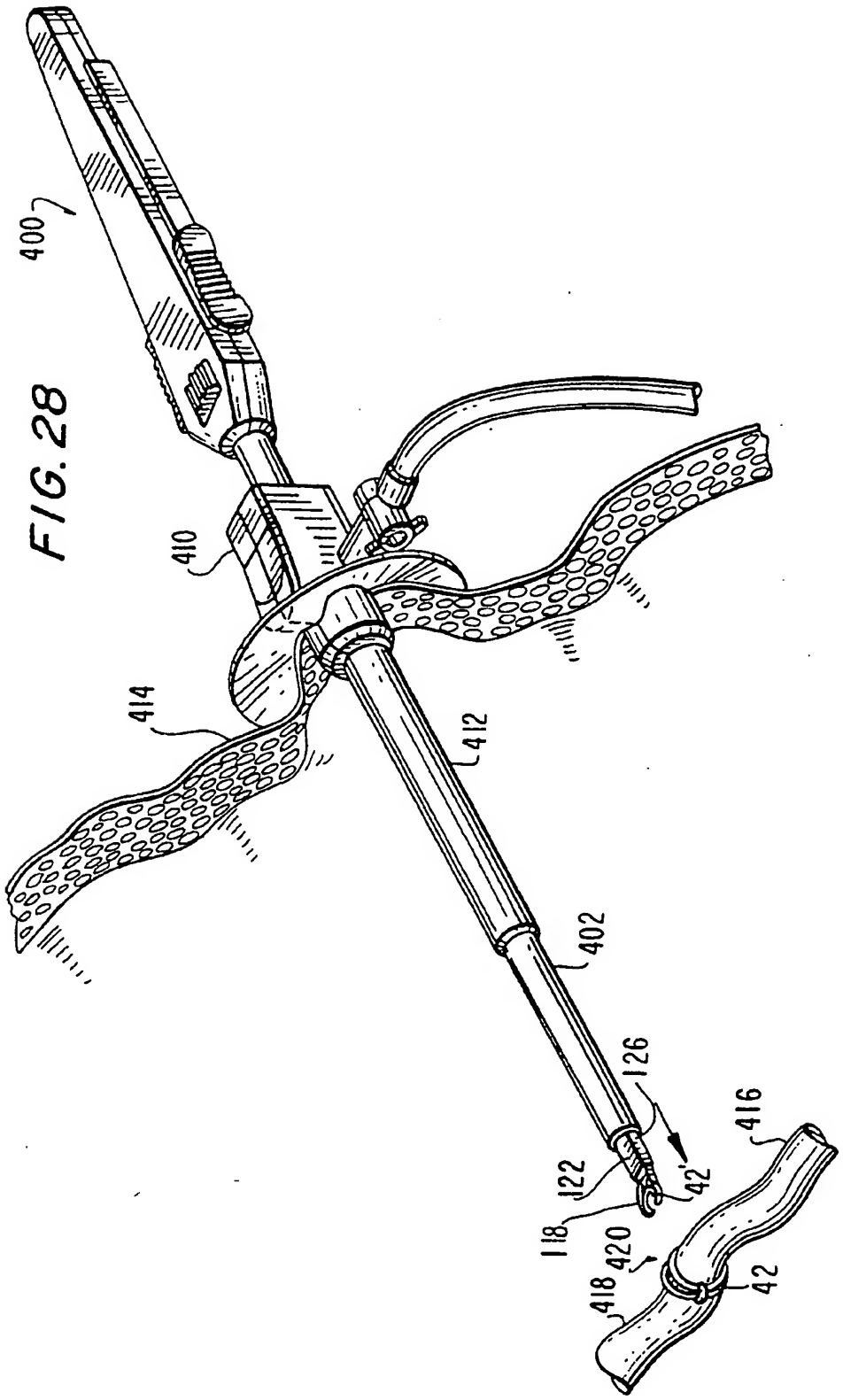
FIG. 28



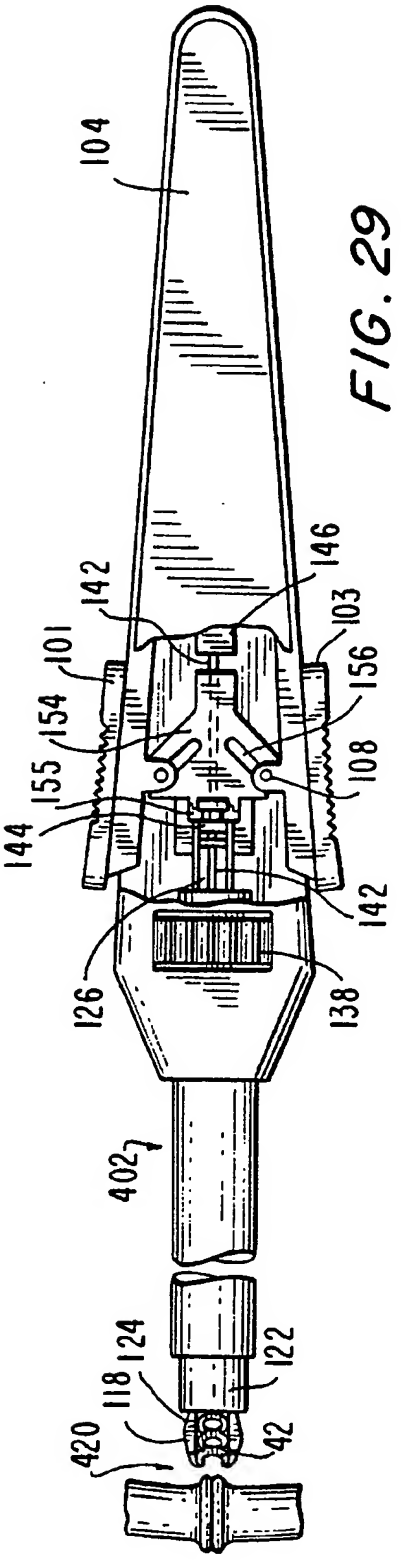

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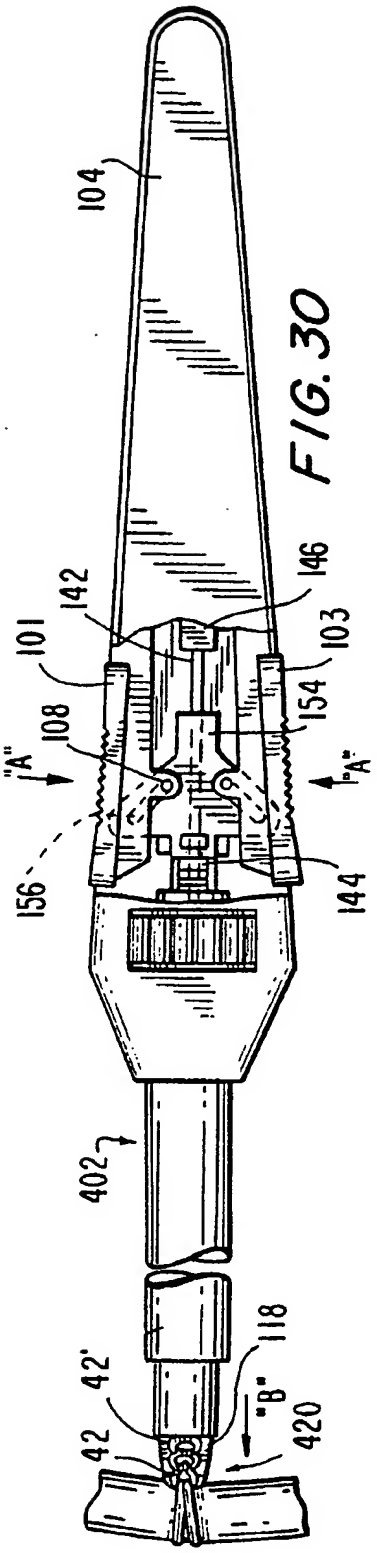
FIG. 29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108
"A"
156
144
402
42'
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"B"
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420

FIG. 30